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The MONTHLY REVIEW

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A Society for the Advancement of the Science of Electro-Plating

NOVEMBER 1936 • IN THIS ISSUE

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An Open Letter to the Branches

Very few of us realize the earnest and sincere endeavor our 1st Vice President, P. J. Sheehan, is making to speed up the membership drive in order to make it a complete success. All but six branches have responded willingly and have appointed live wire members to carry out the plans outlined in Mr. Sheehan's letter.

In all probability the few who have not yet responded will do so at their next meeting, but as this is a business proposition, we are asking the following Branches to fall in line with the others and cooperate at once so that no time will be lost — Bridgeport, Dayton, Los Angeles, Montreal, Pittsburgh and Providence. Springfield was on the same list but at their regular meeting on Monday night, October 26, Mr. Frank Clark was appointed chairman of the Membership Drive. Before the November issue of the REVIEW reaches the members, we feel sure the other Branches will have made their appointments and plans as suggested.

We have just received a card from Mr. Eichstaedt of Detroit Branch sending us the names of two members who have been reinstated. He stated also that this was part of the result of the new membership drive.

The matter of reinstating a member in arrears is proving a stumbling block in many branches. We know of several cases where the members were suspended for non-payment of dues over three years ago. These men want to come back into our organization again but they balk at paying the full amount as required by Article VII, sec. 2 and 3 of the Constitution which reads as follows:

> Sec. 2: Members whose dues are not paid within three months after the beginning of a fiscal year shall be considered in arrears and shall be suspended until said dues have been paid.
>
> Sec. 3: Members whose dues for any previous year remain unpaid at the ending of any fiscal year shall be dropped and may be reinstated only upon application, accompanied by a remittance of all moneys due the Society by the unanimous consent of the members of the Branch Society of which he was a member.

Since Article VII states that at the end of the year any member owing dues for that year should be dropped without further dispensation, therefore any member suspended cannot owe more than one year's dues, since according to the article mentioned he is automatically suspended at that time. Any branches therefore who have been so kindly disposed as to have paid the per capita tax on members who should have been suspended at the end of the first year cannot require these members to pay more than one year's arrears.

The executive board has now under consideration a recommendation that the article mentioned be interpreted to read as follows: that no suspended member can owe more than one year's dues, and that such a sum should be the maximum charge for reinstatement. The Secretary of this board will very shortly communicate to all branch secretaries the agreement reached on this matter which should be clear and definite and should eliminate the uncertainty connected with the reinstatement of members as contained in the article just mentioned.

In the meantime the drive continues and new members are being elected.

Application blanks can be had from Mr. Sheehan's office. We are also having printed extra copies of the REVIEW each month. These, we will be glad to mail to the branches free of charge. Appoint your membership committee at once and notify Mr. Sheehan. Get in touch with every prospective plater, active or associate. Bring him to the meeting. Introduce him to the boys. Make him feel the warmth of your welcome, then keep up your interest in him until he becomes a regular attendant and a booster for the A. E. S.

ADDITIONAL MEMBERS OF THE SPECIFICATIONS COMMITTEE

Mr. W. M. Phillips, Chairman of the Research Committee makes the following announcement:

It has been decided to increase the Joint Specification Committee of the American Society for Testing Materials and the American Electro-Platers' Society by two each. I have, therefore, selected Dr. W. A. Wesley, International Nickel Co., Bayonne, N. J., and Mr. C. F. Nixon of the Ternstedt Division of General Motors, Detroit, Michigan.

Summary of Studies on Electrodeposition at the National Bureau of Standards[1]

By W. BLUM[2]

Read at the Cleveland Convention 1936

I. INTRODUCTION

In this brief summary of the activities on electrodeposition at the National Bureau of Standards during the past year, no attempt will be made to give the results of the investigations. These will be included in some of the papers to be presented here by other members of our staff. The chief purpose of this paper is to show the scope of our studies and their relation to various agencies interested in electrodeposition.

During the past year A. Brenner, who had been assigned to another section of the Bureau during the preceding two years, was returned to the electrodeposition work, and W. G. Schlecht was also employed as a laboratory aide. These additions made it possible to render more assistance in the preparation of specimens for exposure tests, and also to devote some time to methods of testing electrodeposits. As R. M. Wick and C. Kasper are still assigned to problems for other Government Departments, it has not been possible to devote as much time to researches on fundamental principles of electrodeposition as is desirable. As opportunity offers, it is planned to extend this phase of our activities.

II. RESEARCHES

1 — *Protective Value of Plated Coatings:*

(a) Zinc and Cadmium. The results of over three years of atmospheric exposure and of laboratory tests of zinc and cadmium coatings on steel have been published in NBS Research Paper 867[3]. Copies of this paper were purchased by the American Electro-Platers' Society and distributed to its members and to subscribers to its Research Fund. A few of the thick coatings that have not yet failed will be retained in the new exposure tests that have just been started.

(b) Non-Ferrous Metals. The plating of over 100 sets, princi-

1 Publication approved by the Director of the National Bureau of Standards of the U. S. Department of Commerce.
2 Chemist, National Bureau of Standards.
3 Journal of Research of the N.B.S., Vol. 16, P.185: Feb. 1936.

pally of non-ferrous metals, but including a few sets of iron and steel, was completed and the specimens were installed by P.W.C. Strausser and C. K. Fewell, employed by the American Electro-Platers' Society. Assistance in their preparation was received from A. Brenner and W. G. Schlecht of the Bureau staff. Details of this program and of experiences encountered in the plating will be reported by Mr. Strausser. Laboratory and accelerated tests will be made on similar specimens.

2 — *Measurement of Thickness of Deposits*:

Because recently adopted specifications are given in terms of the minimum rather than the average thickness of coatings, rapid, reliable methods for measuring the local thickness are desirable. The dropping test is applicable to electroplated zinc and cadmium coatings. W. G. Schlecht has confirmed its value for hot-dipped and sherardized zinc coatings.

A study was made by A. Brenner of the "chord" method recently proposed by F. C. Mesle. The results described in Research Paper 866[4] and summarized in the MONTHLY REVIEW for April, 1936, show that for coatings 0.0002 inch or more in thickness, this method gives very reliable results on flat surfaces or those with a simple curvature. For complicated shapes, microscopical measurements of cross sections are more accurate, but are more laborious.

3 — *Measurement of Adhesion of Deposits*:

For many purposes the utility of electrodeposits depends upon their adhesion under severe conditions of exposure or wear. It would be highly desirable for inspection purposes to have a method by which the adhesion of a coating on a finished article of any shape could be measured quantitatively. In the absence of such a method, measurements of the adhesion of coatings on specimens prepared under specified conditions may prove very useful for defining the favorable conditions of operation. Methods for this purpose have been described by A. Ollard in England and by P. Jacquet in France. Ollard's method depends upon measuring the load required to detach a coating on the end of a cylindrical rod; while Jacquet's method involves the load necessary to peel the coating from a flat strip.

In a preliminary study of this subject, with nickel deposits on different base metals, A. Brenner has found that each of the

4 Journal of Research of the N.B.S., Vol. 16, P.171; Feb. 1936.

above methods yields results that serve to measure large differences in adhesion, for example on different base metals such as steel and cast iron. Neither method is very reproducible, or suitable for studying the effects of minor changes in methods of preparation. It was found that, as reported by the above authors, when the adhesion is very good, a portion of the base metal adheres to the coating when it is detached. It is hoped to study further the above and other promising methods for measuring adhesion.

4 — *Rapid Deposition of Iron*:

During the past two years, C. Kasper has studied methods for depositing nickel and iron very rapidly, with special reference to the reproduction of printing plates at the Bureau of Engraving and Printing. The results with nickel were reported last year, and this year a brief report on the rapid deposition of iron will be presented. It has not yet been found practicable to apply the most extreme conditions to commercial operatons, but further efforts will be made in this direction.

5 — *Copper Cyanide Solutions*:

The widespread use of cyanide solutions in electroplating justifies more extensive study of their constitution and behavior. Several years ago plans were made for such studies at this Bureau. Methods of purifying and analyzing alkali cyanides were then investigated by M. R. Thompson. R. M. Wick reported upon methods of analyzing silver cyanide baths, and upon the reactions involved in their decomposition. This study has been interrupted for a few years, but Mr. Thompson has now renewed his work in this field.

The next subject to be studied will be the composition and constitution of copper cyanide solutions, upon which there is much contradictory evidence in the literature. It is hoped that more exact knowledge will lead to the explanation and prediction of the behavior of such baths during electrolysis, for example the marked changes in cathode efficiency that are sometimes observed.

III. SPECIFICATION AND TESTING OF PLATED PRODUCTS

The tentative specifications for nickel, chromium, zinc and cadmium deposits on steel that were adopted last year by the American Electro-Platers' Society and the American Society for

Testing Materials have been widely circulated. It is hoped that they will be extensively applied, either literally, or with such minor changes as may appear desirable for specific applications. As occasion arises for revision of Federal Specifications, consideration is being given to the incorporation of the new or similar requirements instead of the present specification of the average thickness of deposits. It is only through a widespread use of such specifications that a sound basis can be found for their revision or their adoption as permanent standards. The results of experiences with them should be communicated to Mr. W. M. Phillips, Chairman of the Joint Committee of the A.E.S. and A.S.T.M. on specifications for plating on steel.

In this connection it is hoped that the testing at the Bureau of Standards of plated products purchased by Federal Departments will be of value not only to the Government, but also to manufacturers, by aiding them to maintain a high quality of plating.

IV. CONTACTS WITH THE PUBLIC

The most extensive contact of the Bureau with the public is through its publications. There has been a considerable demand for the recent papers on the protective value of plating in addition to the several thousand copies that have been distributed by the A.E.S. and by manufacturers. A list of the Bureau publications on electrodeposition will be sent free upon request.

Over 100 persons visit the Bureau each year to confer upon problems in electroplating, and over 100 letters are answered each month. Additional contacts are made through travel, involving meetings of technical societies and committees and visits to plants. Addresses on the results of the joint researches have been presented to ten meetings, many of which were joint meetings, for example of the A.E.S., A.S.T.M., Electrochemical Society, American Chemical Society, American Society of Metals, and similar organizations. These meetings demonstrate the increased interest in electroplating, and also furnish an opportunity for a valuable exchange of experience and opinions. An effort will be made to continue our researches and to increase their value to the entire plating industry by cooperation with the A.E.S., A.S.T.M., and other interested organizations.(Applause)

PRESIDENT SLATTERY: Is there any discussion of Dr. Blum's paper?

DELEGATE A. HIRSCH (Philadelphia, Pa.): Dr. Blum, in the

application of Mesle's method, it is extremely difficult to get that glass in order to measure. I was wondering if you could give us some advice as to where that glass could be purchased.

DR. BLUM: That is an interesting development. The lens that is described in the article was simply a low-power magnifying glass with a scale, which happens to have been made in France. It is one that belongs to Mr. Strausser and had been bought some time in the past years. It had been imported. We supposed it was just a common garden variety of lens which would be very easy to pick up anywhere, but I have been told by others what Mr. Hirsch says; that it has been difficult to get a lens corresponding to that.

I have taken this up with a few of the firms that manufacture optical instruments as well as those that make special instruments for research work, and while there is no difficulty in getting a lens of that kind made, it is a little more expensive, frankly, than I had expected it would be. If you can order a thousand of them, or in quantities like that, I imagine the price would be very reasonable, but I can state from the information I could get that it would probably cost $10.00 each to have them made up.

You can, of course, use just an ordinary scale and a pocket lens, but the difficulty with most of these scales is that when you magnify them they are not any good because the marks in the scale are as wide as the graduations. So that is a slight limitation, and all I can say is that I hope somebody will be progressive enough to put out a lens that will prove convenient at a reasonable price for the purpose.

PRESIDENT SLATTERY: Dr. Blum, if there is no further discussion on your summary, I think it would be opportune at this time for us to hear the report of the Joint Committee of the A.E.S. and the A.S.T.M.

REPORT OF JOINT COMMITTEE ON EXPOSURE TESTS OF PLATING ON THE NON-FERROUS METALS

During the past few years an investigation has been under way on the protective value of various electroplated coatings applied to ferrous metals. This investigation has been reported upon in the National Bureau of Standards Research Papers Nos. 712[1], 724[2] and 867[3], and has also been referred to in the reports of the A.S.T.M. Committee A-5 on Corrosion of Iron and Steel and in detailed reports in the MONTHLY REVIEW of the American Electro-

Platers' Society. A similar investigation has now been undertaken with respect to the value of electroplating on non-ferrous metals. A Joint Committee has been organized consisting of the following, which committee is responsible for the details of conducting this investigation:

Name	*Address*	*Representing*
W. Blum (Chairman)	National Bureau of Standards, Washington	NBS
W. M. Phillips	General Motors Corp., Detroit	AES
Joseph Sexton	Sargent Co., New Haven, Conn.	AES
B. H. McGar	Chase Brass and Copper Co., Inc., Waterbury, Conn.	AES
C. L. Hippensteel	Bell Telephone Labs., Inc., New York City	ASTM
J. R. Freeman, Jr.	American Brass Co., Waterbury, Conn.	ASTM
J. C. Fox	Doehler Die Casting Co., Toledo, Ohio	ASTM

GENERAL PLAN OF EXPOSURE TESTS

Specimens of various non-ferrous metals, as outlined in the accompanying Table I, have been electroplated as indicated in the succeeding tables and have been exposed at six test locations, utilizing the same test sites as were used for the exposure tests on plated steel specimens. The exposure tests include the continuation of certain specimens from the earlier investigation of coatings on steel and some repeat tests on steel specimens, as outlined in the tables. The specimens will be inspected at regular intervals by members of the Joint Committee and other interested individuals.

All of the specimens in these exposure tests are flat plates 4 by 6 in. Most of the rolled metals are of No. 22 gage (0.031 in.) and the cast metals are from 0.1 to 0.2 in. in thickness. The base metals were donated with one side polished. The chemicals and anodes used in plating the specimens were also donated. The specimens were plated at the National Bureau of Standards under controlled conditions so as to produce coatings of uniform quality and known thickness. This work was done by the research associate and research assistant employed by the American Electro-Platers' Society, with considerable assistance from the Bureau staff. Subsriptions to the research fund of the A.E.S. were received from its treasury and from a large number of firms. The cost of mounting the specimens was paid by the A.S.T.M.

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[1]William Blum, P. W. C. Strausser and Abner Brenner, "Protective Value of Nickel and Chromium Plating on Steel," National Bureau of Standards Journal of Research, Vol. **13**, No. 3, September, 1934, p. 331.

[2]P. W. C. Strausser, Abner Brenner and William Blum, "Accelerated Tests of Nickel and Chromium Plating on Steel," National Bureau of Standards Journal of Research, Vol. **13**, No. 4, October, 1933, p. 519.

[3]William Blum, P. W. C. Strausser and Abner Brenner, "Corrosion-Protective Value of Electrodeposited Zinc and Cadmium Coatings on Steel," National Bureau of Standards Journal of Research, Vol. **16**, No. 2, February, 1936, p. 185.

Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys and Committee B-6 on Die-Cast Metals and Alloys. Information and advice were received from members of the Joint Committee and many other interested persons.

BASE METALS

The test racks in each exposure location provide sufficient space for 112 vertical rows of 5 specimens each. Seven of these rows are used for the retention of specimens started in 1932, and 2 rows are used for holding one unplated specimen of each of the non-ferrous metals in the tests. The remaining 103 rows are used as shown in Table I, which lists the composition and source of each base metal.

METHODS OF PLATING

The solutions and methods of plating were similar to those used in plating the steel specimens and which have been reported in the National Bureau of Standards Research Papers Nos. 712 and 867. The detailed conditions of plating, including the composition of each solution, temperature, current density and other essential conditions have been presented in a report to the A.E.S. by P.W.C. Strausser.[1] In general, 12 specimens were plated at one time on two racks of 6 specimens each. During the plating of the zinc specimens and the zinc-base die-casting specimens, the cathode rod was moved mechanically.

The principal materials used in the plating of the specimens are listed in the following table:

Materials	*Donated by*
Chromic acid	Mutual Chemical Company of America
Sodium cyanide	The R. and H. Chemicals Dept.
	E. I. du Pont de Nemours and Co., Inc.
Copper cyanide	The R. and H. Chemicals Dept.,
	E. I. du Pont de Nemours and Co., Inc.
Copper sulfate	The Grasselli Chemical Co., Inc.
Sodium sulfate	The Grasselli Chemical Co., Inc.
Nickel sulfate	The Harshaw Chemical Co.
Nickel chloride	The Harshaw Chemical Co.
Anode bags	The Harshaw Chemical Co.
Nickel anodes	The International Nickel Co., Inc.
Buffing compounds	Hanson-Van Winkle-Munning Co.
Buffs	Hanson-Van Winkle-Munning Co.

SCHEDULE OF ELECTRODEPOSITED COATINGS

Coatings on Ferrous Base Metals:

(a) Continuation of Previous Tests. At each location where

certain of the previously exposed sets of steel specimens have a rating of 3 or better, either 2 or 3 specimens of these sets will be retained on the test racks, as shown in Table II. For details of the preparation of these specimens, see Research Papers Nos. 712 and 867[1].

(b) Repetition of Former Tests. The sets shown in Table III were prepared exactly like the corresponding sets and on the same steel (No. 1 Cold-Rolled Steel) as described in Research Paper No. 712. The prefix "S" for steel has been inserted to distinguish these coatings from those on other base metals.

(c) Additional Coatings on No. 1 Cold-Rolled Steel. Different coatings were applied on the same lot of No. 1 cold-rolled steel as that used in the continuation of the previous tests (Item (a), Table II) and in the tests repeated on the former sets (Item (b), Table III). These coatings are shown in Table IV.

(d) Coatings on Different Steels and Irons. The coatings on the other steel and iron-base metals included in the tests are shown in Table V.

Coatings on Non-Ferrous Base Metals:

(a) Copper and Brass. The coatings on the various copper and brass base metals are shown in Table VI.

(b) Zinc and Zinc-Base Die-Castings. The coatings on the various zinc and zinc die-cast base metals are shown in Table VII.

EXPOSURE AND INFECTION

The specimens were mounted on the exposure test racks during April and May, 1936, in the six locations used for the exposure tests of plated steel that were started in 1932; namely, Key West, Fla.; New York, N. Y.; Pittsburgh, Pa.; Sandy Hook, N. J.; State College, Pa.; and Washington, D. C. They will be inspected at regular intervals by members of the Joint Committee and any other interested persons. A schedule of the inspection dates, and any other information desired regarding these tests will be furnished on request addressed to the chairman of the Joint Com-

[1]P. W. C. Strausser, "Observations on the Plating of Non-Ferrous Metals for Outdoor Exposure Tests." Mimeographed Proceedings, Convention of Am. Electro-Platers' Soc., 1936; also Monthly Review, Am. Electro-Platers' Soc., Vol. No. 23, (1936). (Copies may be obtained from Mr. W. J. R. Kennedy, Executive Secretary, American Electro-Platers' Society, 90 Maynard St., Springfield, Mass.)

mittee, Mr. William Blum, National Bureau of Standards, Washington, D. C.

Respectfully submitted on behalf of the Joint Committee,

WILLIAM BLUM, *Chairman.*

Table I — Composition of Base Metals

	Base Metal	No. of Sets	Description of Base Metal	Composition, by Analysis, per cent					Donated by
FERROUS METALS									
				Carbon	Manganese	Phosphorus	Sulfur	Silicon	
No. I	Steel	12	Cold-rolled S. A. E. No 1010[a]	0.10	0.43	0.006	0.017	<0.01	American Steel & Wire Co.
No II	Steel	2	Full cold-rolled	0.07	0.39	0.013	0.034	<0.01	Stanley Works
No. III	Steel	2	Spring	0.83	0.66	0.023	0.026	0.17	General Spring & Bumper Co.
No IV	Iron	2	Gray, cast	3.46	0.48	0.64	0.08	2.82	American Stove Co.
No. V	Iron	2	Malleable	1.64	0.27	0.12	0.13	0.93	Nat'l Malleable & Steel Casting Co. Polished by Westinghouse Electric & Manufacturing Co.

NON-FERROUS METALS

				Copper	Lead	Tin	Aluminum	Manganese	Nickel	Iron	Zinc	
No. VI	Copper	4	De-oxidized	99.9	...	...	....	....	....	<0.01	....	Revere Copper & Brs., Inc.
No VII	Brass	7	Cast, High A.S.T.M. B 65-28[c]	60.9	2.6	1.0	0.32	....	0.05	<0.05	35.1	Crane Co.
No. VIII	Brass	3	Cast, Low-Ounce Metal A.S.T.M. B 62-28[d]	85.4	5.5	4.7	....	....	....	<0.01	4.4	Sargent and Co.
No. IX	Brass	3	Extruded A.S.T.M. B 16-29[e]	62.3	2.9	<0.05	....	....	<0.05	<0.1	34.6	Scovill Mfg. Co.
No. X	Brass	18	Rolled, High A.S.T.M. B 36-33[f]	65.7	<0.1	....	....	....	....	<0.01	34.2	Chase Brs. & Copper Co Inc.
No. XI	Brass	4	Rolled Low (Alloy L, Com. B-3)[g]	85.0	...	....	....	....	....	<0.01	15.0	Bridgeport Brs.Co.
No. XII	Nickel-Brass	5	Rolled (Fed. Spec.)[h]	64.6	...	....	....	0.23	18.2	<0.2	16.8	American Brs Co.

[a] S.A.E. Handbook, 1936 Edition, p. 254, Soc. Automotive Engrs.

No. XIII	Nickel-Brass	5	Cast (Fed. Spec.)[h]	66.5	3.7	3.4	....	....	18.9	<0.2	7.2	Standard Sanitary Mfg. Co.

				Zinc[b]	Copper	Aluminum	Iron	Lead	Magnesium	
No. XIV	Zinc	6	Rolled	98.4	0.99	...	0.017	0.62	....	The New Jersey Zinc Co.
No. XXI	Zinc	7	Die-Cast A.S.T.M. Alloy No. XXI[i]	93.8	2.2	4.0	0.009	....	0.02	Doehler Die Casting Co. & The New Jersey Zinc Co.
No. XXIII	Zinc	21	Die-Cast A.S.T.M. Alloy No. XXIII[i]	96.1	....	3.9	0.005	....	0.04	Doehler Die Casting Co. & The New Jersey Zinc Co.

[c]Standard Specifications for Yellow Brass Sand Castings for General Purposes (A.S.T.M. Designation: B 65), 1933 Book of A.S.T.M. Standards, Part I, p. 597.

[d]Standard Specifications for Composition Brass or Ounce Metal Sand Castings (A.S.T.M. Designation: B 62), 1933 Book of A.S.T.M. Standards, Part I, p. 612.

[e]Standard Specifications for Free-Cutting Brass Rod for Use in Screw Machines (A.S.T.M. Designation: B 16), 1933 Book of A.S.T.M. Standards, Part I, p. 719.

[f]Standard Specifications for Sheet High Brass (A.S.T.M. Designation: B 36), 1933 Book of A.S.T.M. Standards, Part I, p. 728.

[g]Report of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys, Proceedings, Am. Soc. Testing Mats., Vol. 32, Part I, p. 218 (1932).

[h]Federal Specification for Builders' Hardware, Lock and Lock-Trim (FF-H-106).

[b]Zinc was determined by difference.

[i]Tentative Specifications for Zinc-Base Alloy Die Castings (A.S.T.M. Designation: B 86-34 T), Proceedings, Am. Soc. Testing Mats., Vol. 34, Part I, p. 706 (1934); also 1935 Book of A.S.T.M. Tentative Standards, p. 369.

< = less than.

TABLE II
COATINGS ON PREVIOUSLY EXPOSED STEEL SPECIMENS[a]

Set	Coating	Coating Thickness, in.					
		Nickel	Copper	Nickel	Chromium	Zinc	Cadmium
No. 6	: Ni[b]	0.002	.....	.....	.....	.....	.....
No. 16	: Ni, Cu, Ni	0.0004	0.0006	0.001	.....	.....	.....
No. 106	: Ni, Cr	0.002	.....	.....	0.00002	.....	.....
No. 116	: Ni, Cu, Ni, Cr.	0.0004	0.0006	0.001	0.00002	.....	.....
No. 154	: Ni, Cu, Ni, Cr	0.0002	0.0003	0.0005	0.0001	.....	.....
No. 206	: Zn (cyanide)	.....	.....	.....	.....	0.001	.....
No. 209	: Zn (cyanide+mercury)	.....	.....	.....	.....	0.001	.....
No. 215	: Zn (high SO_4)	.....	.....	.....	.....	0.001	.....
No. 218	: Zn (dextrin)	.....	.....	.....	.....	0.001	.....
No. 219	: Zn (hot dip)	.....	.....	.....	.....	0.0009	.....
No. 305	: Cd (cyanide)	.....	.....	.....	.....	.....	0.001
No. 309	: Cd (cyanide+gulac)	.....	.....	.....	.....	.....	0.001
No. 312	: Cd (cyanide+gulac+Ni)	....	.....	.....	.....	.....	0.001
No. 403	: Zn 90 per cent, Cd 10 per cent	.....	.....	.....	.....	Zinc+Cadmium 0.001	

[a]All coatings were plated on No. 1 cold-rolled steel.

[b]Except as noted, all final nickel coatings were buffed, whether or not they were chromium plated.

TABLE III—COATINGS ON STEEL SPECIMENS USED IN REPETITION OF FORMER TESTS[a]

Set	Coating	Coating Thickness, in				Variation
		Nickel	Copper	Nickel	Chromium	
No. S 1	: Ni	0.001	.....	.....	.....	Standard[b] nickel
No. S 101	: Ni, Cr	0.001	.....	.....	0.00002	Standard[b] nickel Chromium
No. S 102	: Ni, Cr	0.001	.....	.....	0.00002	Cathode pickle
No. S 106	: Ni, Cr	0.002	.....	.....	0.00002	Thickness nickel
No. S 113	: Ni, Cu (acid), Ni, Cr	0.0002	0.0003	0.0005	0.00002	Acid copper layer
No. S 114	: Ni, Cu (cyanide), Ni, Cr	0.0002	0.0003	0.0005	0.00002	Cyanide copper layer
No. S 116	: Ni, Cu (acid), Ni, Cr	0.0004	0.0006	0.001	0.00002	Acid copper layer

TABLE IV
ADDITIONAL COATINGS ON COLD-ROLLED STEEL NO. 1

Set	Coating	Coating Thickness, in.				Variation
		Nickel	Copper	Nickel	Chromium	
No. S 171	: Ni, Cu (cyanide), Ni, Cr	0.0002	0.0005	0.0003	0.00002	Final nickel thinner than No. S 114
No. S 172	: Ni, Cr	0.001	.....	.....	0.00005	Chromium thicker than No. S101
No. S 173	: Ni, Cr	0.001	.....	.....	0.0001	Chromium thicker than No. S172
No. S 174	: Ni, Cr	0.002	.....	.....	0.0001	Chromium thicker than No S106
No. S 175	: Ni, Cr	0.001	.....	.....	0.0002	Nickel with air agitation

TABLE V — COATINGS ON BASE METALS OF DIFFERENT STEELS AND IRONS

Set	Des. of Base Metal	Coating	Coating Thickness, in				Variation
			Nickel	Copper	Nickel	Chromium	
No. S 181	Cold-rolled steel, No. II	Ni, Cr	0.001			0.00002	Standard
No. S 182	Cold-rolled steel, No. II	Ni, Cr	0.001			0.00002	Cathode pickle
No. S 191	Spring stl. No. III	Ni, Cr	0.001			0.00002	Standard

[a] All coatings were applied to No. 1 cold-rolled steel; and all final nickel layers were buffed.
[b] The term "standard" in this and succeeding tables refers merely to a procedure used as a basis of comparison and does not imply superiority.

No. S 192	Spring stl. No. III	Ni,Cu(cyanide), Ni,Cr	0.002	0.0003	0.0005	0.00002	Cyanide copper layer
No. I 1	Gray iron No. IV	Cu[a](cyanide), Ni, Cr		0.00005	0.002	0.00002	Copper flash
No. I 2	Gray iron, No. IV	Cu[a](cyanide), Ni, Cr		0.001	0.001	0.00002	Thick copper
No. I 3	Malleable iron, No. V	Cu[a] (cyanide), Ni, Cr		0.0005	0.002	0.00002	Copper flash
No. I 4	Malleable iron, No. V	Cu[a](cyanide) Ni, Cr		0.001	0.001	0.00002	Thick copper

TABLE VI—COATINGS ON COPPER AND BRASS BASE METALS

Set	Coating	Coating Thickness, in.			Variation
		Copper	Nickel	Chromium	
		On Copper (No. VI)			
No. C 1	Ni, Cr		0.0002	0.00002	Standard
No. C 2	Ni, Cr		0.0005	0.00002	Thickness nickel
No. C 3	Ni, Cr		0.0005	0.00002	Citrate anodic etch
No. C 4	Cr[a]			0.002	Direct chromium
		On Cast High Brass (No. VII)			
No. B 1	Ni, Cr		0.0002	0.00002	Standard
No. B 2	Ni, Cr		0.0001	0.00002	Thickness nickel
No. B 3	Ni, Cr		0.0005	0.00002	Thickness nickel
No. B 4	Ni, Cr		0.0002	0.00001	Thickness chromium
No. B 5	Cu (cyanide), Ni, Cr	0.0005	0.0002	0.00002	Copper flash
No. B 6	Ni, Cr		0.0002	0.00002	H_2SO_4 anodic etch
No. B 7	Cr[a]			0.0002	Direct chromium
		On Cast Low Brass (No. VIII)			
No. B 11	Ni, Cr		0.0002	0.00002	Standard
No. B 13	Cu (cyanide), Ni, Cr	0.00005	0.0002	0.00002	Copper flash
No. B 14	Cr[a]			0.0002	Direct chromium
		On Extruded Brass (No. IX)			
No. B 21	Ni, Cr		0.0002	0.00002	Standard
No. B 23	Cu (cyanide), Ni, Cr	0.00005	0.0002	0.00002	Copper flash
No. B 24	Cr[a]			0.0002	Direct Chromium
		On Rolled High Brass (No. X)			
No. B 31	Ni, Cr		0.0002	0.00002	Standard
No. B 32	Ni, Cr		0.0001	0.00002	Thickness nickel
No. B 33	Ni, Cr		0.0002	0.00003	Thickness chromium
No. B 34	Ni, Cr		0.0005	0.00002	Thickness nickel
No. B 35	Ni, Cr		0.0002	0.00001	Thickness chromium
No. B 36	Ni, Cr		0.0003	0.00002	Thickness nickel

[a] These coatings were buffed.

No. B 37	Ni, Cr		0.0002	0.00005	Thickness chromium
No. B 38	Ni		0.0002		No chromium
No. B 39	Cr			0.00003	Direct chromium, thin
No. B 40	Cu (cyanide) Ni, Cr	0.00005	0.0002	0.00002	Cyanide copper flash
No. B 41	Cu (acid), Ni, Cr	0.00005	0.0002	0.00002	Acid copper flash
No. B 42	Ni, Cr		0.0002	0.00002	Nickel not buffed
No. B 43	Ni, Cr		0.0002	0.00002	Citrate anodic etch
No. B 44	Cr[a]			0.0002	Direct chromium, thick
No. B 45	Ni, Cr		0.0002	0.00002	H_2SO_4 anodic etch
No. B 46	Ni, Cr		0.0002	0.00002	Low pH nickel
No. B 47	Ni, Cr		0.00005	0.00002	Thickness nickel
No. B 48	Ni, Cr		0.0002	0.00002	Nickel with air agitation
	On Rolled Low Brass (No. XI)				
No. B 51	Ni, Cr		0.0002	0.00002	Standard
No. B 53	Cr[a]			0.0002	Direct chromium
No. B 54	Ni, Cr		0.0002	0.00002	H_2SO_4 anodic etch
No. B 55	Ni, Cr		0.0002	0.00002	H_2SO_4 anodic etch, low pH nickel
	On Rolled Nickel Brass (No. XII)				
No. N 1	Cr[a]			0.0002	Direct chromium
No. N 2	Cr			0.0001	Thickness chromium
No. N 3	Cr			0.00005	Thickness chromium
No. N 4	Ni, Cr		0.0001	0.0001	Thickness nickel and chromium
No. N 5	Ni, Cr		0.0002	0.00002	Standard
	On Cast Nickel Brass (No. XIII)				
No. N 11	Cr[a]			0.0002	Direct chromium
No. N 12	Cr[a]			0.0001	Thickness chromium
No. N 13	Cr[a]			0.00005	Thickness chromium
No. N 14	Cu (cyanide), Ni, Cr	0.00005	0.0002	0.00002	Copper flash
No. N 15	Ni, Cr		0.0002	0.00002	Standard

TABLE VII—COATINGS ON BASE METALS OF ZINC AND ZINC-BASE DIE CASTINGS

S - Standard nickel bath
HS - High sulfate nickel bath

Set	Coating	Coating Thickness, in. Copper	Nickel	Chromium	Variation
	On Rolled Zinc (No. XIV)				
No. Z 1	Ni (HS), Cr		0.0005	0.00002	Standard
No. Z 2	Ni (HS), Cr		0.0003	0.00002	Thickness nickel
No. Z 3	Ni (HS), Cr		0.0005	0.00003	Thickness chromium
No. Z 4	Ni (HS), Cr		0.0005	0.00001	Thickness chromium
No. Z 5	Ni (HS), Ni (S), Cr		(0.0002 (0.0003	0.00002	"Duplex" nickel
No. Z 6	Cu(cyanide), Ni (S), Cr	0.0002	0.0003	0.00002	Copper layer

[a]These coatings were buffed.

On Zinc Die Castings (Alloy No. XXI)

No. Z 11	Ni (HS), Cr	0.0005 (0.0002	0.00002	Standard
No. Z 12	Ni (HS), Ni (S), Cr	 (0.0003 (0.0002	0.00002	"Duplex" nickel
No. Z 13	Ni (HS), Ni (S), Cr	 (0.0008	0.00002	"Duplex" nickel thickness
No. Z 14	Cu (cyanide), 0.0002 Ni (S), Cr	0.0003	0.00002	Copper layer
No. Z 15	Cu (cyanide), 0.0001 Ni (S) Cr	0.0009	0.00002	Thickness copper, nickel
No. Z 16	Cr[a]		0.0001	Direct chromium, cold
No. Z 17	Ni (HS), Cr	0.001	0.0002	Thickness nickel

*This coating was buffed.

On Zinc Die Castings (Alloy No. XXIII)

No. Z 19	Ni (HS)	0.0005		Standard nickel
No. Z 20	Ni (HS)	0.0003		Thickness nickel
No. Z 22	Ni (HS), Cr	0.0005	0.00002	Standard nickel,chromium
No. Z 24	Ni (HS), Cr	0.0003	0.00002	Thickness nickel
No. Z 25	Ni (HS), Cr	0.0005	0.00001	Thickness chromium
No. Z 26	Ni (HS), Cr	0.0005	0.00003	Thickness chromium
No. Z 31	Cr[a]		0.0001	Direct chromium, hot
No. Z 33	Cr[a]		0.0001	Direct chromium, cold
No. Z 35	Ni (HS), Ni (S), Cr	(0.0002 (0.0003 (0.0002	0.00002	Standard duplex nickel
No. Z 36	Ni (HS),Ni (S),Cr	 (0.0003 (0.0002	0.00001	Thickness chromium
No. Z 37	Ni (HS),Ni (S),Cr	 (0.0008 (0.0002	0.00002	Thickness nickel
No. Z 38	Ni (HS),Ni (S), Cr	 (0.0018	0.00002	Thickness nickel
No. Z 40	Cu (cyanide), 0.0002 Ni (S), Cr	0.0003	0.00002	Standard copper, nickel,
No. Z 41	Cu (cyanide), 0.0004 Ni (S), Cr	0.0006	0.00002	Thickness copper, nickel
No. Z 42	Cu[a](cyanide), 0.0005 Ni (S), Cr	0.0015	0.00002	Thickness copper, nickel
No. Z 43	Cu(cyanide), 0.0003 Ni (S), Cr	0.0002	0.00002	Ratio copper/nickel
No. Z 45	Ni(HS), Cu 0.0003 (cyanide),Ni(S),Cr	(0.0002 (0.0005	0.00002	Inter. copper layer
No. Z 47	Ni(HS),Cr	0.001	0.00002	Thickness nickel
No. Z 48	Ni(HS), Cr	0.0002	0.00002	Thickness nickel
No. Z 49	Cu[a](cyanide), 0.0005 Ni(S),Cr	0.00075	0.00002	Thickness copper,nickel
No. Z 50	Cu[a](cyanide), 0.0005 Cr		0.0002	Chromium over copper

These coatings were buffed.

The Electrodeposition *of* Zinc

By GEORGE B. HOGABOOM
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Read at Cleveland Convention 1936

WITH the interest that has been recently created in electrodeposition of zinc it is advisable to ascertain all the conditions under which a zinc coating can be consistently produced that will not only be equal to what is now being done but that will be better.

For a long time electroplated zinc coatings have not been up to the standard required. The protection against corrosion obtained was often less than expected. In many cases a comparison with a hot dipped coating of equal weight electrodeposited zinc was definitely inferior. Recently, however, data has been assembled that is placing electrodeposited zinc on an equal basis with hot galvanizing and there is the promise that it may prove, in many cases, superior.

Looking at the electroplating process squarely it must be admitted that the reason for the adverse situation was that the electroplater has not given sufficient study to the preparation of the metal, the anodes used and the character of the deposit. With the careless thought that the zinc metal was by nature a protecting metal for steel and iron against the action of that insistent enemy of ferrous metals—corrosion—the electroplater just went through the indefinite series of operations and coated iron or steel with zinc. If the coating looked like zinc that was satisfactory as the magic properties of the zinc itself was expected to cover and overcome all the shortcomings of the plating processes.

It is little wonder then that cadmium that was deposited under definitely controlled conditions and gave a more attractive finish, stepped out from obscurity to a place beyond zinc, regardless of cost, in such a brief period after its intelligent introduction. And still more strange, it was not until there was a shortage of cadmium for electroplating purposes that any real thought was given to the improvement of the processes employed in the electrodeposition of zinc. One notable exception merits not only attention but interested and unstinted commendation. Dr. U. C.

Tainton developed a process for depositing zinc at a current density that went beyond the limit of imagination for the production of a commercial coating. It is only a few days ago that the mention of depositing zinc of more than 0.001" in one minute and do this on a commercial productive basis would have caused comments with a smile of incredulity — yet today that very thing at 1000 amperes per sq. ft. is being done. The electroplater is indebted to the ingenuity and perseverance of Dr. Tainton and to the steel company that had the foresight to encourage him.

That process along with the decrease of cadmium for electroplating has directed attention to the production of better zinc coatings.

There has been data published on the protective value of electrodeposited zinc in the proceedings of a large scientific society whose object is to set up standards. Upon reading the reports there is the unfortunate omission of essential information of the preparation of the basis metal, the composition of the zinc solution used, the current density employed, and the thickness and character of the zinc coating. Cannot the unprejudiced question be asked of what value any data assembled has upon the life of electrozinc coating compared with the coating produced by any other method? The electroplater and the plating engineer have a right to ask that question.

If it is necessary to prepare the surface of a metal so that an acceptable ornamental electrodeposited coating may be had, is it not equally or even more essential that the preparation of the basis metal be as good, if not better, if the value of the article is dependent upon the protective life afforded by the electrodeposited coating? Then the basis metal must be clean and free from imperfections that will prevent a good electrodeposit of zinc.

There is an insistent demand that the anodes for nickel or copper be of the highest purity and corrode in the plating soltion without even a trace of metallics. Has the same quality of zinc anodes been demanded or are such detrimental impurities as lead being accepted complacently because of a slight differential in cost? How about the sludge formed on the anode due to oxidation of these impurities and its affect upon the character of the deposit that is to give up its life to protect the basis metal? In the plating solution in which an anode of pure zinc is attacked

when no current is flowing, thereby forming a partially chemically corroded sludge are the laws of electrodeposition different from those governing the deposition of any other metal? Will not the particles of sludge created by the impurities or by this partial chemical corrosion have an electrical charge and be carried over to the cathode, not mechanically but electrically, and be the cause of rough and porous deposits? The anode must corrode only when the current is on and be as free from sludge and metallics as is demanded for any other anode.

The statement has been made that porosity of zinc deposits is not necessarily detrimental; that zinc will throw a protective influence over the steel or iron where porosity exists and prevent corrosion. Is that wholly true? While zinc has that very valuable property, is it not also the fact that where the basis metal is exposed that the protection given is due to an electrochemical reaction; that a cell is set up and that the rate of corrosion is increased at that spot? If there is considerable porosity or inclusions in the deposit will not the total sum of these numerous electrolytic cells materially decrease the protective life of the zinc coating? If the basis metal is clean and the coating of zinc is continuous, free from porosity, will not the same weight or thickness of zinc afford a longer life of protection? If, then, the value of electrodeposited zinc is based upon its protective life, more attention must be given to the method of producing the zinc coating.

You well know my opinion on "What is Under the Plate"—the effect of the basis metal on the structure of the electrodeposit.

The question is now asked what effect has the structure of the deposit upon the protection of the basis metal, especially the structure of a zinc deposit? Are all zinc deposits alike? If not then what effect have they on the protective life of the basis metal when exposed to atmospheric conditions; upon any accelerated test for the determination of the thickness of the coating which has been set up as a standard for a specified life? Apparently no, or very little, thought has been given to the influence of the structure of the deposit in setting a value upon zinc coating. If the structure of the deposit has any effect whatever then what will bring about the changes in the structure of the deposit and how can a relatively uniform structure be maintained? The

answer seems to be in the composition of the plating solution and the methods used in its operation.

Electrozinc coatings are being given the opportunity to prove themselves. What the status of zinc coating will be in the future depends in a very large measure upon the electroplater. He must know the basis metal, the methods of preparing it for plating, the zinc anodes, the composition and control of the plating solution and the character of the electro-deposited coatings. Until all of this is known, any data on the value of electrozinc coatings or any specifications for the thickness of the deposit must be tentative and subject to revision. The electroplater can either firmly establish electrozinc coatings as superior to that produced by any other method or through carelessness and neglect pass up the opportunity that has been brought to his very feet.

To obtain data upon which further investigation can be based experimental runs were made with zinc solutions. Solutions were made that had different percentage composition of the three component parts—the metal, the sodium cyanide, the sodium hydroxide. Commercial salts were used. The anodes were high purity cast zinc containing a definite percentage of aluminum and mercury. These anodes permitted a maintaining of a predetermined current density at a fairly constant pressure as there was no polarization of the anodes. The cathodes were rolled steel 2″ x 4″ which gave an area on both sides of 1/9 of a sq. ft. The anodes were of the same size, but as they were a slight distance from the wall of the glass cell, therefore some of the backs of the anodes were, no doubt, active and this gave a larger anode area than that of the cathode. The container was a glass battery cell about 4″ x 10″ which held 3.5 liters—3 liters of solution were used. The distance between anode and cathode was constant—about 4.5″. A current density of 15 emperes per sq. ft. was used, except as recorded. The pressure varied according to the resistivity of the solution. The time of running for microphotographs was 12 hours; that for the thickness determination was for 15 minutes, except for three runs. The solutions were run at room temperature. The results of the experiments are given in the micrographs, curves, and data in the illustrations.*The structure of the electrodeposit was first studied. The micrographs are all 200x. There is a marked difference in the character of the deposit from the different solutions used both with the higher and the lower metal

concentration—the lower concentration is always one-half of the composition of the higher concentration. Two solutions were run in series, i. e., #1 and #2, #3 and #4, #5 and #6. Solution #1 is what has been called a "standard" solution; #7 has a composition found best for a bright zinc solution, and was run at 40 amperes per sq. ft.

During the runs it was noted that to deposit zinc from solutions #3 and #4, which had a low sodium hydroxide content, a pressure of 6 volts was required, which is quite high. The micrograph indicated that the deposit was thin and that when the higher metal concentration was used the structure was unusual. It was thought that the resistivity of the solution was high; and, this was proved by a measurement of the resistivity which was made through the courtesy of Mr. M. R. Thompson, National Bureau of Standards. See plate #3.

It will be noted that the solution is not clear until the sodium hydroxide is about 5-oz. per gallon. This proves that sodium hydroxide is needed to take zinc cyanide completely into solution. This indicates also that if the sodium hydroxide content of a zinc cyanide solution is permitted to go below 5-oz. per gallon that there will be suspended salts in the solution, and in all probability this will cause a polarization of the cathode and that is, no doubt, the reason for the peculiar structure of the electrodeposit. The resistivity of the turbid solution is high.

In the solutions run there is a marked difference in the resistivity in relation to the sodium hydroxide concentration. In solutions having a low sodium hydroxide content it was reasoned that the cathode efficiency was low and that accounted for the thin deposits. Several runs were made in a previous research that indicated that this was true, and a repetition of some of the work proved it. Plate #4 illustrates the results obtained from a comparison of the Cathode Efficiency and the Current Density. When the sodium hydroxide is high the cathode efficiency is high in solutions with high or low metal content and at all current densities. When the sodium hydroxide is low the cathode efficiency is very low. A composite picture of the effect of varying the concentration of the sodium hydroxide and the sodium cyanide is given in Plate #5, Fig. 1.

Generally one would be led to assume that if the cathode efficiency of a plating solution were high that the throwing power

would be good. In many cases a solution that gave excellent results in a still tank did not work well in a plating barrel unit. This was thought strange until a comparative study was made of the relation between the cathode efficiency and the throwing power of the zinc cyanide solution. The results (Plate # 5, Fig. 2) indicate that the concentration of sodium cyanide and sodium hydroxide must be reversed if good throwing power is desired. The throwing power of an acid zinc solution was found to be very poor. The question immediately arose that if the throwing power of an acid zinc solution were so low, what was the structure of the electrodeposit and what was the influence of the addition of substances, or of any change in the composition of the solution? Time did not permit obtaining these data, but again the Bureau of Standards, through Dr. William Blum, came to my assistance. The effect of current density on both the surface and the crystal structure of the deposit is shown in Plate # 6. The effect of pH and of the addition of dextrine on the structure of the deposit from an acid zinc solution was determined. (See Plate # 7).

If a plater runs his zinc solution at a definite current density for a stated time, in view of the data assembled, would he get the results expected? The effect of the composition of the plating solution is shown and there is only one conclusion, and that is, that to obtain zinc deposits that will be fairly uniform all the ingredients of the plating solution must be kept within reasonable limits by periodic chemical analyses. Observation of the color or of the physical appearance of the deposit tells nothing. The thickness of the deposit must be ascertained if specifications are to be met, especially if the time of plating and the reading of the ammeter are depended upon to give the required results.

There are two methods by which the thickness of an electrodeposit of zinc are measured—the microscope and the "Dropping Test." As the structure of electrodeposited zinc is influenced by the composition of the solution, the pH value and the addition agents used, how do these two methods compare? It is well-known that metals having a different crystal structure are attacked by acids at a different rate. To obtain some light on this, steel cathodes 2″ x 4″ were plated for 15 minutes at 15 amperes per sq. ft. in solutions in which the composition varied as in the study of the structure of the deposit. As the cathodes were plated

on both sides, and as there was an equal distance between each anode and the cathode, it was assumed that the structure was practically identical on both sides. Several measurements were made of the deposit on one side with a microscope adapted for measuring the thickness of electrodeposits of metal. The deposit on the other side of the cathode was measured by the "Dropping Test."

It was found that in a "standard" solution the thickness of the deposit measured by each of these methods was within the range stated that would be had by previous investigators. From solutions in which the sodium hydroxide content was low, very thin deposits were obtained. This was what was expected as the data on the cathode efficiency predicted. An examination of the structure of the deposit also showed a distinct difference. There was also a greater percentage difference between the thickness of the deposit when measured by the microscope and when measured by the "Dropping Test." This indicated that the percentage difference of the two methods depended upon the composition of the solution used.

While it is realized that there would be a thinner deposit from some solutions, it was not expected that the difference would be so great or that there would be such a contrast between the two methods used for ascertaining the thickness of the deposit. If there were such a difference in the cathode efficiency of solutions when measured by a coulometer, and, there were wide variations in the thickness of the deposit when measured by the two methods used, it was thought probable that the cathode efficiency could be determined by measuring the thickness of the deposit. It was recognized that there is a difference in the thickness of the electrodeposit on any article due to what is called the effect of local current density. The measurements of the thickness of the zinc deposit on the test plates used, due to the care used in plating, were very slight and, therefore, the average of several readings was thought to be representative and could be used as a basis for calculating the cathode efficiency. It is known that this cannot be done on all classes of work plated by production methods. From the electrochemical equivalents it was calculated that at 100% efficiency a deposit from a run at 15 amperes per sq. ft. for 15 minutes would be approximately .00028″ thick. It was a simple matter to then calculate the cathode efficiency of the

solutions operated in this research. In all cases the efficiency indicated by the microscope measurements of thickness compared well with those obtained with a coulometer.

There was, as stated, a marked difference between the results obtained by the microscope and those obtained by the "Dropping Test". An examination of the structure of the zinc deposit from solutions of similar composition clearly indicated that the rate of attack of the solution used in the "Dropping Test" was influenced by the structure of the deposit. The results are tabulated in Plate # 8.

This work should be confirmed by other investigators. It is of importance to learn what influence the structure of the electrodeposit from any plating solution has upon the wearing qualities and its protective value against corrosion. If it is confirmed, then investigators in electroplating must take into consideration the efficiency of the plating solution in their research work. The plater must know the efficiency of the solutions used if he depends upon the reading of the ammeter and the time consumed when plating to meet specifications. (Applause)

CHAIRMAN SODERBERG: The paper is open for discussion.

DR. BLUM: I believe that we can agree authoritatively with everything Mr. Hogaboom has said. I am not going to question the importance of these statements for an instant. The magnitudes are the things that are of practical concern. In other words all of these things must be taken into account. The question is as to just how much effect they are likely to have in one or another condition.

I do not question for an instant that the structure of a zinc deposit will have some effect on its protective value. I simply state that from the experience of our exposure tests and others that have been recorded, it is surprising that the effects are not larger than they are. In other words, if you have zinc deposits of a given thickness, for example a cyanide solution and an acid solution, where the structure is quite different — the grain size — at least the differences in our exposure tests were not greater than ten per cent. I just mention that as showing that while all these things must be taken into account, it is fortunate in a sense, from the standpoint of the use of zinc, that the protective value is not so susceptible to these effects as might be the case with some other metals.

This whole thing of evaluating these results is tied up with the idea of getting either measurements of thickness or measurements of protective value with a high accuracy. I am not disparaging those last measurements of Mr. Hogaboom when I call attention to the fact that the results with the dropping test and with the microscope were not in close agreement and I am not willing to admit in advance that the dropping test was necessarily wrong. In general, we have given greater credence to the microscopic measurement of the thickness of the coatings, because it seems to offer possibilities of eliminating error.

On the other hand, when an attempt is made to polish and measure under a microscope a metal coating as soft as zinc you have the extreme case that Mr. Hogaboom cited, where he did actually have some zinc deposited that he could detect in a dropping test. He could not even see it under a microscope. Of course, that was an extreme case. However, the fact remains that unless a person is, prehaps, expert in polishing and examining zinc coatings, it is not at all certain that you can get results within ten or fifteen per cent, even with a microscope.

One of our staff in the Metallurgy Division had that experience. Just as a sort of check, we would take a piece and cut it in the center and then have him measure the thickness of zinc at various places on that edge and on the other edge. He reported results of the measurements as different although the two were separated only by the width of a knife cut and the deposit was apparently smooth. We know that one or the other of the measurements was not correct. In other words, we had circumstantial evidence that measurements with the microscope are not necessarily accurate with zinc deposits. I mention that only as showing that while again it may be — I am not questioning the fact — that the difference in the structure of zinc deposits may produce a difference in the dropping test, still you can not base that necessarily on the microscopic test, because that may also be in error.

The whole thing points to the fact that we have to get greater accuracy in making our measurements in order to draw safe conclusions. I am going to refer again to something different. Mr. Meyer published in the last month's Metal Industry an article on testing zinc deposits with the antimony chloride solution, and so forth. It happened that fortunately from the

standpoint of the electroplaters his results were very consistent with electrodeposited zinc, but as soon as he got the hot dip coatings, and the same would be true of sherardized coatings, he found the determinations were not the same as for the antimony chloride zinc because of some iron in the zinc deposits.

Again, I am not questioning those results at all when I say that if, as Mr. Meyer has subsequently told me, the difference was usually not more than five or ten per cent, then I say that until we can measure these protective values more closely than five or ten per cent it is fortunate that we do not have to worry over those differences.

It comes up in connection with specifications where, for example, some of the federal and other specifications simply state that a zinc or cadmium coating of not less than a certain minimum thickness shall be used, and that would include hot dip sherardized or electroplated coatings. There is no use trying to measure those coatings with one per cent accuracy when we do not know whether they are equivalent to ten or fifteen per cent. We do not know from the tests we have made and the A. S. T. M. tests, as far as they can be correlated, that the three different types of zinc coatings are about equivalent. I hope that you will all see my position. Everything Mr. Hogaboom said is true, and yet it remains to be seen how important any particular effect is in practice.

MR. HOGABOOM: I should like to say that if I made something that was absolutely correct, it would be a phenomenon or miracle. While I realize that what they do at the Bureau of Standards is the last word in polishing and etching, nevertheless it would probably be of interest to know how these specimens were polished and etched and measured. The whole seventeen samples were put in one clamp. The electrodeposited zinc piece was put in and next to that in the first test was a piece of steel — a very thin piece of steel — and then the electrodeposit. In other measurements nickel was deposited upon the zinc.

We tried copper and we found we could not get good results by depositing copper, especially in the cyanide solution, as we found that some of the zinc went into solution and we got a difference in reading. So we used nickel and then put the steel in between. The sample was polished and then treated with hydrochloric acid, just swabbed over with a piece of cotton wet

with hydrochloric acid, so as to remove any metal that would be flowed over on the steel from the piece that was deposited or the steel insert between. That slightly etched and made the zinc black, giving a straight line of black between the two bright steel parts. The measurements were quite accurate. It was done by a young man for whom I have a great deal of respect — my own son, who has become quite proficient in these measurements.

DR. BLUM: That is what I was saying, that Mr. Hogaboom had obtained better results than we. I say that with all sincerity. One must use a particular coating and work with that. You can not simply take miscellaneous coatings and get a result for zinc that is as accurate as we would like it to be, but at best, I think Mr. Hogaboom's results bear that out. It is difficult, especially with a very thin coating, to get the exact result.

MR. HOGABOOM: We could see the line, but we just could not get any definite readings, and, therefore, we so stated.

CHAIRMAN SODERBERG: Are there further comments?

MR. STRAUSSER: I should like to have a little more information as to how Mr. Hogaboom was able to determine the thickness of test specimens numbers ten and fourteen where the thicknesses were the order of .000006 and .000005.

MR. HOGABOOM: We used a stop watch.

MR. STRAUSSER: What type of stop watch?

MR. HOGABOOM: The Bureau of Standards stop watch.

MR. STRAUSSER: With a split second?

MR. HOGABOOM: Yes. We bought one especially for that and had it standardized.

DR. GRAHAM: I feel that in presenting a paper such as Mr. Hogaboom has presented it is unfortunate that in this organization we do not have the opportunity of seeing a pre-print of the paper. I should like to suggest for the consideration of the Electro-Platers' Society that if the mimeographed report of the convention could be so got together that the paper could be available before the meeting and discussion could be added to it and then bound, it would give the opportunity of more intelligently discussing the contents of some of these very excellent papers. I

felt that way about some of the other papers that have been presented to the convention this year.

I think Mr. Hogaboom is to be congratulated on his courage in presenting the results which are so contradictory in some respects to our general ideas, and yet as we analyze them, I think we can draw some very definite and valuable conclusions.

Regarding the relative accuracy of the test for measuring thickness, it would seem that on measuring a thin coat, your percentage of error would be relatively greater, and naturally it would lead to some diversion, such as we have seen. This fact is definitely established: That in the hands of, let us say, more than an average operator, so far as skill in carrying out both the microscopic measurements and the drop test are concerned, you will have some variations. Specifications are fine, but I can cite one after another of the specifications that appear in our bound volumes, such as that of the A.S.T.M., in which there will definitely be limits of accuracy between which tests can be made. If Mr. Hogaboom has done nothing more than to bring to our attention the fact that in the hands of experienced operators thickness measurements are going to be subject to variations within definite and sometimes rather wide limits, we cannot be too argumentative in discussing such results between companies, laboratories and individuals. Certainly the test does give us an opportunity of saying whether we are well over a specified limit as given by a specification, if we are certain we do exceed that minimum in measurement by a substantial amount.

So far as the other data in the paper is concerned, I feel there are a number of interesting points. I do not want to enter into a prolonged discussion of it because I do not feel competent to do so on such short notice from the angle of review which he has presented. However, there is one point that I feel might enlighten us, or assist us, in evaluating the paper. Where you are considering the structure of deposits you get from baths of white ferric composition, if we are looking at it primarily from the standpoint of what appears to be a dense, fine grain structure, we would be inclined to be in favor of certain types of composition. If we are looking at it from the point of view of what will give us a dull zinc deposit, protective value, it could possibly be interpreted in

one way; if we are looking at it from the point of view of producing a bright plate, we might interpret it differently.

To illustrate that difference which I have in mind, the Blum and Hogaboom formula 8-3-7 observation for just ordinary plating, apparently gives as good a color, free from stain, and valuable operating characteristics, high efficiency, and so on, both at the anode and cathode, so that you can conclude that is a very good practical bath. When you go to these higher concentrations not of metal but of cyanide and caustic combined, then Mr. Hogaboom clearly shows you do get higher efficiencies. Naturally you get a change in structure, but I would conclude from the general comments of Mr. Hogaboom that the higher concentration caustic primarily, with a higher total caustic and cyanide than the Blum-Hogaboom formula, was favored for the structure of deposit that was obtained. If I am not correct in that, I should like to be corrected. It depends entirely upon what your objective is as to just which general composition might be a favorable composition.

One rather significant point presented was that when you got to a composition where the cyanide and caustic were equal, such as in the 8-7-7 bath, previous work showed that when you got up to that concentration you had practically one hundred per cent efficiency at both the anode and cathode. Then beyond that concentration, by either increasing cyanide or caustic, your efficiency for a certain limit was continued at a high value.

It seems strange that in those baths beyond that point you should find all these advantages in regard to structure and high efficiency, and yet in ordinary plating, the 8-3-7 bath, on general observation of the appearance of the deposit, seems to be such a favorable composition. I think, therefore, that that distinction between the 8-3-7 common plating bath composition and these higher compositions should be more clearly defined. Apparently where you are striving to obtain a particular resulting structure, it is so dependent upon the efficiency and the other factors that enter into that deposit that possibly these higher compositions are more especially designed for the particular object that you wish to attain. To look at the entire sheet and draw any one conclusion from it as to what solution is best would be very mis-

leading. If Mr. Hogaboom would further either confirm or enlighten me as to that distinction, I should appreciate it.

MR. HOGABOOM: One of the things that has influenced the use of the different concentration solutions is the brightness of the deposit. While it is admitted and known that the 8-3-7 solution gives a very good characteristic white deposit, it has not the brilliancy of these from solutions with the higher concentrations. Where bright deposits of zinc are now demanded in the place of cadmium, those are the ones in which there is the most interest. So it was not to show a marked difference between 8-3-7 and the other solutions used, but to watch for the brightness. It has also been found, from our experience, that where certain addition agents are used, the higher concentrations of caustic and cyanide are of extreme advantage.

I was hesitant to present this paper because I was fearful lest what has happened would happen, and that is a discussion of the measurements rather than what I wished to bring out, that is, the fact that the plater must control his solutions. He must know what he is doing if he wishes to use either the drop ratio or the microscopic method for measuring the thickness of deposits. That is the point that I wished to bring home and not a discussion of the relative values of the two methods of measurement.

In answer to Dr. Graham's statement that it would be fine if this Society could have pre-prints, I must say for the Chairman of this Committee, for the Cleveland Convention, Mr. Nachtman, that was his object. He did his best to obtain all papers by April first so that he could have them published. I, unfortunately, was one of those who could not complete the work. I tell you frankly that I did this work over four times. I could not believe my results. I am upset over making a difference between two tests that have been accepted. I want to impress upon you the importance of controlling your solutions and knowing what you are doing in order to obtain a firm hold on the opportunity that we have.

The micrographs, curves and illustrations referred to in this article are contained in the Proceedings of the Cleveland Convention. Persons desiring to consult them may do so by applying to any Branch Secretary, or by writing to the office of the Executive-Secretary.

The Future *of* Cadmium Plating

By MR. GUSTAF SODERBERG
UDYLITE CO.

Read at Detroit Branch Meeting

THE future of any material or process depends largely on the size of what Dr. Gillette of Battelle Memorial Institute calls its "supremacy area". This expression involves consideration of availability, price and properties. As Mr. Lindahl has already spoken about the first two of these factors, my talk will deal mainly with the latter one, the properties of cadmium plate and of cadmium plating solution.

When we talk about the properties of cadmium, we probably think first about the resistance to corrosion which it imparts. There are several types of corrosion which are of interest, namely, atmospheric corrosion, corrosion by chemicals and corrosion determined by the presence of other metals in contact.

On the first subject I want to point out that the value of the A. E. S. — A. S. T. M. tests is limited by the experimental conditions. It should be noted that the test specimens were exposed facing the sun and subjected to direct rainfall. Many parts exposed out of doors are in a much more shielded position. Thus we found that in simple tests here in Detroit, thin coatings which broke down in six months on our roof, lasted over three years on nuts on automobile wheels. However, there is no question but that when parts are subjected to conditions similar to those of above mentioned tests, particularly in industrial atmospheres, such heavy coatings must be applied that cadmium ordinarily becomes too expensive. If corrosion only is a factor, the use of cadmium is ordinarily limited to such corrosive conditions where thin plates are sufficient.

In this connection it is sometimes important to note that the corrosion products of cadmium do not accumulate like those of zinc. Thus, it may be necessary to use cadmium in order to keep exposed mechanisms working smoothly. This, I understand has been brought out very clearly on several applications by the Navy.

When we talk about the corrosion resistance of cadmium, we generally compare it with zinc. It is just as correct to compare

it with nickel or copper or tin and when we do so, we find that cadmium is very much superior and that relatively thin cadmium coatings stand up as well as much heavier coatings of metal just mentioned.

The largest proportion of cadmium plating is employed on parts used indoors. Here we generally want a nice appearance and one which lasts. This is easily obtained with thin coatings of cadmium. Zinc is not as suitable because even when really bright zinc is obtained by careful manipulation in the plating shop, the bright zinc coating tarnishes and discolors more quickly than cadmium because of the higher reactivity of the zinc itself.

Cadmium is not generally resistant to chemicals. However, within definite limited ranges of pH it has a satisfactory resistance. Some work published in 1932 by Roetheli and co-workers indicate in general a fair resistance of cadmium in solutions of pH higher than 6. Zinc also has a similar range of relatively high corrosion resistance but this is limited to pH equal to 9-12.5. Outside these ranges zinc dissolves very rapidly.

This week we had occasion to compare the resistance of zinc and cadmium to boiling 20 g/l and 40 g/l trisodium phosphate solutions. Our results indicated that cadmium was not touched at all by the weak solution, while zinc dissolved at an average rate in the neighborhood of .000005″ per eight hour day. In the more concentrated solution cadmium increased in weight as if about .000005″ of cadmium had been added during each eight hour day, while zinc decreased in weight to the extent of about .000012″ per eight hour day. The corrosion curves are not straight lines by any means, but show how films are formed and break down.

Because of this resistance to alkaline solutions, cadmium plating has found a field for coating floor cleaning machines, mops and the like. It is used to a very great extent on clothes wringers. We have on record washing machine covers which have lasted over ten years without any evidence of rust, the machine having been used from two to five times a week. Cadmium is also used on structural work which is imbedded in cement or terra cotta, as used by the building industry.

As indicated above, cadmium does not withstand acids of any

strength to speak of. However, in the packing industry the machinery gets coated with rancid greases containing oleic and stearic acid and cadmium has proven to stand up very well on such machinery. Its use in this industry is limited by the fact that it is not allowed to come in direct contact with food products because of the possible danger of poisoning.

Cadmium is quite frequently used in contact with other metals. Mr. Whitmore of Wright Field reported in '33 some intermittent immersion tests in sodium chloride solution of duralumin sheets in which had been inserted rivets of various metals and with various coatings. Prior to the corrosion test, the sheet had the strength of about 60,000 lb. per square inch and an elongation in 2″ of 18%. Aluminum and annealed duralumin rivets decreased the strength in ten days to about 45,000 lbs. and about 5% elongation. Tinned steel rivets, heat treated duralumin rivets and 18-8 steel rivets decreased the strength to about 37,000 lbs. and the elongation to a little over 3%. Copper and brass rivets decreased the strength to about 31,000 lbs. and the elongation to about 2% while cadmium plated rivets decreased the strength only to about 56,000 lbs. and the elongation to 16%. Microscopic examination of the area around the rivets and potential measurements supported these findings.

Cadmium is used to a considerable extent to protect brass from corrosion, the potential difference between the two metals being much smaller than that between brass and zinc. When brass and steel parts are in contact with each other they are generally best protected by cadmium.

I will now leave the discussion of corrosion and take up some other properties which increase the supremacy area of cadmium. The first one is the low electrical contact resistance which is found between cadmium plated surfaces. Equally low contact resistance is obtained between perfectly clean copper surfaces, but as soon as copper oxidizes the resistance increases. Heating copper in the air for one hour at 210°C increased the contact resistance about 50 times at a contact pressure of 20 lbs. per square inch, and about 225 times at 50 lbs. per square inch. The contact resistance between freshly cadmium plated surfaces was about four times that of perfectly clean copper at 20 lbs. per square inch and 2½

times at 500 lbs. per square inch. This increase disappeared entirely on heating the cadmium plated contacts for one hour at 210°C. Heating to 310° which is quite close to the melting point of cadmium, the cadmium became coated with cadmium oxide and the contact resistance increased about four times at 20 lbs. per square inch and about twice at 500 lbs. per square inch. Some tests made by a big electrical company comparing cadmium, tin and silver in a somewhat similar manner showed tin to have a contact resistance equal to twice that of cadmium and silver from 6 to 35 that of cadmium. Intermittent heating and cooling tests of bus bar joints coated with tin over zinc, cadmium, silver, tin and plain copper in which the current was gradually increased over a four months period showed the tin and the cadmium to be very much better than the plain copper and somewhat better than the silver plate — this conclusion being based on temperature rise and contact drop over the joints.

As a consequence of the above, cadmium is very broadly used in the electrical industry.

Another reason why cadmium is employed is the fact that it solders easily. The ordinary non-corrosive rosin fluxes can be employed, while for soldering to zinc plate it is necessary to use acid fluxes. These fluxes are seldom removable and cause corrosion and electrical leaks.

An English research published a couple of years ago compared the ease of soldering to cadmium and to tin. The tests were run both in the laboratory and on a production basis and the authors concluded that there was nothing to choose between the two coatings insofar as speed of soldering and consumption of solder was concerned.

The ease of soldering is another reason for the extended use of cadmium plating in the electrical industry and particularly in the radio industry. Zinc is not satisfactory either from this standpoint or from the standpoint of appearance of plate.

One property of cadmium which has been largely overlooked during the development of cadmium plating is the fact that it has very good bearing metal qualities. Ordinary bright cadmium has been used to some extent on cheap ball bearings, worm gears and ball joints. A more detailed study has indicated that still better results are had with exceedingly ductile cadmium applied

from especially designed baths. Very heavy thicknesses up to .03″ have been applied in perfectly smooth condition (several samples shown). These coatings are very close to the cadmium alloys now applied to steel backs by hot dipping. However, some difficulties have been encountered when the bearings were subjected to very high temperatures, in that the originally fine grained cadmium plate recrystallized and gave large grain of less adhesion to the base metal. There is evidently an upper limit here, but unquestionably there is a considerable field for cadmium plate where good frictional properties are desired.

So far I have discussed the properties of cadmium plate. I wanted to add a few words about the plating process itself. Cadmium is perhaps the easiest metal to plate. Thus, it covers malleable iron very nicely while zinc does not, in many cases. Our own experience has been that at least half of the samples of malleable iron which have been sent to us for bright zinc plating did not cover properly. It is also easier to plate cadmium over aluminum or over zinc die castings. A factor to be taken into consideration is that cadmium requires less rigid oxide and grease removal than zinc. This, together with the fact that cadmium solutions are simpler, less critical and easier to analyze is sometimes a important factor when the total cost of plating is concerned. Another factor of this nature is the faster plating which is had with cadmium in barrel solutions. This involves less equipment, floor space, generator capacity, etc.

Some people may have an idea that the use of cadmium plating is declining. Our experience is contrary to this. Taking our sales of cadmium in pounds for 100% in 1929, they dropped to about 53% in '32, rose to 78% in '33, 112% in '34 and 139% in '35. Because of the increased consumption of cadmium, both by the plating industry and the bearing industry, a number of our customers were forced to go to zinc. Our sales in 1936 will probably not be much different from those in 1935. The number of users is smaller, but most of them are taking more cadmium.

I hope that this discussion has been of some assistance to you in defining in your own mind where you can use cadmium profitably and to advantage and that a step has been taken in the direction of more closely defining the supremacy area of this type of plating.

Mr. Barrows' Membership Report

At the opening Session of the Cleveland Convention, President Slattery asked Mr. Walter Barrows of Toronto Branch to read what was done to increase the membership of Toronto Branch 40% during the past year. In connection with the enthusiastic response by nearly all our branches given to the membership drive under the leadership of Vice President P. J. Sheehan of Milwaukee Branch Mr. Barrows' paper is published as read.

To the Officers and Members of Toronto Branch, American Electro-Platers' Society:

The following constitutes my report of activities, successes and failures as Membership Secretary from September 9, 1935 to May 16, 1936. Together with comments re impressions formed while engaged in the work.

The work involved has been pleasant, exchange of correspondence was limited to only a few, but these prospects proved to be seriously interested.

Number of names and addresses of prospects obtained			61
" of names and addresses of prospects written to			57
" of replies from prospects			31
" of application forms requested mailed			24
" of application forms mailed			25
" of application forms obtained with fees			16
" of letters received promising early future application			7
" of letters received promising immediate application			11
" of these promises which were actually kept			9
" of addresses from which no reply was received			35
" of prospects written to only once	16	Number Elected	9
" of prospects written to twice	33	Number Elected	3
" of prospects written to three times	10	Number Elected	1
" of prospects awaiting election	3		
" of application forms now in hands of prospects			10
" of prospects who have attended meetings but who have not made application			4
" of suspended members who have requested advice re reinstatement			8
" of suspended members reinstated			3
" of members elected from Toronto District			6
" of members elected from other cities of Ontario			7
" of phone calls requesting information re application			5
" of requests from members re plating methods, etc			4
" of letters written members asking them to aid in securing a prospect with whom we had corresponded			3
First letter of season was written September 9, 1935			
Last letter of season was written May 16, 1936			
Addresses regarded as useless			2
Total number of pieces of mail sent within Toronto District			65
Total number of pieces of mail sent outside Toronto District			110
Total cost for postage			$4.64
Three pieces of mail requiring 5c postage each were sent out			

It will be observed that 57 prospects were sent letters and 31 replied, 24 of whom requested application forms.

From these 24 prospects 14 applications with fees were obtained.

Eight prospects out of eleven who promised immediate return of filled in forms and the required fee kept their promise. This would indicate that previous consideration and decision had been made.

Now let us analyze the report respecting number of letters required to get results.

We note that nine elections resulted from sixteen prospects to whom only one letter was written prior to receipt of application by your membership secretary.

Only three elections resulted from thirty-three prospects to whom two letters were written, and only one election from ten prospects to whom three letters were written. All of which seems to indicate that if a prospect is seriously desirous of joining the society he will act after one reminder or invitation is placed in his possession. Furthermore, the qualifications of these men are usually beyond question. They are not of the old hard boiled type of plater. They are generally studious, observant and progressive. If they do not prove to be members who retain membership through successive years it is seldom because of failing interest in plating or the activities of the society unless declining years and inactivity compels or induces them to resign or fall out.

Only three out of thirty-three prospects to whom two letters were sent were elected. Thirty men, recognized as electro-platers failed to exert themselves to the extent of writing us a post card. Naturally, we may regard these men as possibilities for the future, but I am not very hopeful of finding many among them that would prove particularly useful in the Society.

One election resulted out of ten prospects to whom three letters were sent. This man was an ex-member and applied for reinstatement. One of the three letters sent this man was in part a reply to a question about a plating problem, therefore, I do not hesitate in saying he deserves a medal. I have an abundance of respect

for a man who has common sense enough to acquit himself in like manner.

Of the eleven prospects who have retained the forms only one has extended us the courtesy of an acknowledgement or statement with reference to intentions for the future. This one is a young man who I have reason to believe will develop into a first class asset of the Society.

Within the territory from which we may legitimately seek new members there are at least fifty formen platers who are well qualified to become members of Toronto Branch A. E. S. There are several reasons why they may never sign an application. Some of the principal reasons are: uncertain employment; employment at reduced rate of pay; lack of knowledge respecting the advantages the Society offers; inability to advance beyond the stage where free and unrestrained discussion of plating topics begins. These are usually men who have been given charge of plating operations simply through force of circumstances and who have continued more or less successfully and always with a false impression respecting their possession of plating secrets which they fear we might induce them to divulge were they members of the A. E. S.

Then there is the fellow who is afraid his employer might object to his becoming a member of the Society. This type is known to exist but is not common in Ontario. There is also the man who has more than his share of domestic tribulations which keep him forever in debt or on the verge of collapse. These men deserve and have my sincerest sympathy, they are satisfied the A. E. S. is a splendid society, they want to become members but duty to home and loved ones prevents the venture. I never attempt to get these men to take a different view, we cannot truly vision the mental or physical effect that domestic conditions may have on the attitude of a conscientious man. If a man of this type eventually becomes a member he almost invariably makes a splendid member, efficient officer and a social favorite.

Suspended members who apply for information respecting reinstatement and fail to apply for reinstatement are usually governed by either their financial status or uncertainty of employment.

There are foremen platers in every industrial center on this continent who are totally indifferent to plating innovations, new ideas, improved methods or the chemistry of plating, because they are employed by firms who maintain a staff of research men or technical advisers who specify type of finish, furnish particulars respecting methods, etc., and the plater has simply to follow directions just the same as he would if a physician prescribed for him. He is merely a medium. Talk with these fellows a few minutes on any plating subject and nine times out of ten times he will inject a topic foreign to plating, such as fishing, baseball, hockey, a horse race, or possibly his chances as a holder of a sweepstake ticket. He would never be worth his per capita tax value to the Society, his interest is not in his work or anything of an educational nature connected with it. If he gets in a jam he applies to the technical staff at the head office.

I have no desire to bore you with my comments and as I see that the latter exceeds space length of the report proper, it may be best to stop right here.

I wish to say, however, the question relative to getting our members to attend meetings is a mighty important one. With a large and attentive gathering each meeting night we might accomplish many things which are impossible with a mere handful. Why not inaugurate a series of meetings in the fall at which some form of light refreshments shall be served at the close of a well-scheduled program? The series may be short and serve merely as a test. It is a well-known fact that the word refreshments on a notice of meeting will often prove more effective as a means of getting members out than a notice announcing the presence of a prominent authority on some phase of the work in which members are engaged. The cost of a trial series of meetings would not break the Branch and the results would prove truly interesting whichever way the experiment leads us to decide for future meetings.

The comments incorporated in this report are purely personal. They are not necessarily facts. If the members present wish to differ with me in any or all respects I shall welcome any constructive criticism or corrections. (Applause)

MEMBERS OF THE A. E. S.

If you can't see Paris in the Spring, try New York City in June. Plan a rendezvous in the heart of Manhattan.

JUNE 14, 15, 16 and 17

To Celebrate The 25th

ANNUAL CONVENTION

IN 1937

The Silver Jubilee

of the American Electro-Platers' Society at New York City

THE PLACE — Hotel Pennsylvania, opposite the Pennsylvania Railroad Station, in the very heart of Manhattan. Ideally located, from the point of view of City activities, spacious, luxurious and comfortable, yet surprisingly reasonable. Splendid accommodations for convention purposes.

THE PLAN — To make your stay in New York City, joyous, profitable and stimulating; a long remembered happy episode.

INNOVATION — Plans are being formulated to hold an outstanding exhibit of PLATED WARE, submitted by manufacturers and members of the various branches.

EDUCATIONAL PROGRAMME — To supply a long felt want, one entire day is to be devoted to the reading of practical papers, submitted by plating room foremen. This in addition to a most interesting and comprehensive programme. To this end, the Chairman of the Educational Committee has assurance of a ready and whole hearted response from the rank and file of our membership.

FURTHER DETAILS — will follow in the forthcoming issues of the "MONTHLY REVIEW", and letters from the several Committee Chairmen. The first letter to the Branch Societies will be mailed during the month of November.

1937 Convention Committee

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Cutting Costs and Increasing Profits Meeting

THE DATE	**MONDAY — NOVEMBER 9, 1936**
THE PLACE	**STATE TRADE SCHOOL AUDITORIUM — HARTFORD, CONN.**
ADMISSION	BY INVITATORY **"GUEST CARD"** ONLY.
THE GREETER	**MR. CHARLES B. WHITTLESEY**—EXECUTIVE VICE-PRESIDENT of the Hartford Chamber of Commerce welcomed the assembly and opened the meeting.
THE SPONSORS	**HARTFORD BRANCH OF AMERICAN ELECTRO-PLATERS' SOCIETY**, whose guest of honor for the evening was **MR. W. J. R. KENNEDY**, Executive Secretary of the National Society, who visited Hartford to attend this meeting.
THE DONORS	**UNITED STATES RUBBER PRODUCTS, INCORPORATED,** whose willingness in co-operating with technical societies programs is receiving nation-wide interest and appreciation.
THE SPEAKER OF HONOR	**DR. H. H. HARKINS**, Director of Development Department of United States Rubber Products, Incorporated, since 1928 — Graduate of the University of Texas — Received his doctor's degree at Yale — Research Fellow at Johns Hopkins University for one year with Professor E. V. McCallum.
DR. HARKINS' SUBJECT	**"HOW RUBBER CUTS CORROSION COSTS"** (in manufacturing plant operations)—Dr. Harkins uses lantern slide illustrations and actual demonstrations in the presentation of this subject on which he has made specialized research for the past eight years.

THE GUEST SPEAKER — **MR. OSMUND S. TRUE**, Manager of Chemical Industry Sales of United States Rubber Products, Incorporated — Graduate of Massachusetts Institute of Technology—Has been actively engaged in application of rubber to corrosive problems for the past eight years.

MR. TRUE'S SUBJECT — **"REAPING REWARDS WITH RUBBER"** — A presentation of new proofs of tried and proven utilizations. Mr. True's presentation also allows for open forum questions, discussions and answers to your problems, if you wish to submit questions from the floor. For those who may wish to submit questions confidentially, questionnaire cards are furnished.

The Meeting Arrangements Committee of the Hartford Branch of American Electro-Platers' Society recognize their good fortune in securing the co-operation of the United States Rubber Products, Incorporated — Dr. Harkins — and Mr. True — for the November meeting, so early this season, when 1937 Cost Cutting subjects are of such valuable importance to manufacturers in many various industries.

The Committee is also grateful for the cooperation and fraternalism so whole-heartedly extended to them by members and officers of

The American Society of Metals
The American Society of Mechanical Engineers
The American Chemical Society
The American Institute of Electrical Engineers
The American Institute of Architects
The American Society of Civil Engineers
The Connecticut Society of Civil Engineers, Inc.
Storts Welding Company, Incorporated

Yours for more Cost Cutting ideas,

THE MEETING ARRANGEMENTS COMMITTEE
OF THE HARTFORD BRANCH OF THE
AMERICAN ELECTRO-PLATERS' SOCIETY

W. E. Bancroft, Chairman
Charles Peterson
W. D. MacDermid

NOTE

A new illustrated booklet on Stevens Buffing Compositions and Metal Finishing Equipment has just been published by Frederic B. Stevens, Inc., Detroit, Michigan.

The booklet describes in detail Stevens Buffing Compositions and their applications, Stevens Zucker Pioneer Rouges and applications and the Mitchell line of Motor Driven Polishing Lathes and Automatic Polishing and Buffing Machines.

A copy will be sent on request.

The Abstract Section

JAMES W. HANLON, *Chairman, Program and Educational Committee*

METALS & ALLOYS ABSTRACTS

PHIL J. RITZENTHALER

1. Pickle Pitting by Electrolytic Potentials — C. H. McCALLAM & D. L. WARWICK *Trans. American Society for Metals* - Vol. **24** 133-53 March 1936 — Data presented to show that pitting during pickling is associated with electrolytic action between scale and metal. Potential of scale was found to be a function of scaling temperature. At lower temperature the potential is practically the same as that of metal and pitting is absent but at higher temperature the difference in potential is marked and deep pitting is likely to occur. The boundary between temperature ranges corresponds roughly to transformation temperatures. Mechanical scale breaking before pickling tends to lessen depth of pit. Inhibitors modify electrolytic action but do not prevent deep pitting.

2. Equipment for Wide Strip Pickling System — *Steel* Vol. **98**: 53-54 May 1936 — Equipment in River Range plant of Ford Motor Company handles strip up to 78″ wide. There are two 240 ft. lines of welded steel tanks lined with rubber which is covered with an inner lining of acid-proof brick jointed with a special sulfur base cement. Lead siphons are used for emptying tanks into steel sewer. Strip is supported between tanks by steel carrier rolls under which are steel drip pans. All acid tanks have sectional flanged steel covers. Steel ducts carry fumes from center of each tank to H_2O spray tanks in which counter current washing and cooling of fumes removes all acid. All steel equipment is rubber lined.

3. Inhibitors in Pickling — P. R. RUSSELL - *Journal American Zinc Institute* Vol. **17**: 81-87 — A good inhibitor must give a bright finish free from non-rinsable discolorment stain or film. It should maintain satisfactory inhibition throughout the life of pickling bath. Many inhibitors give high initial inhibition, but action drops off sharply in a very short period. No obnoxious odors or fumes should be given off and inhibition must not cake in shipping containers. An inhibitor must be easily soluble and should not be so active that action of acid on scale is slowed up enough to impair operating schedules. A good inhibitor results in an overall reduction of 30-40% in acid consumption. Under ideal conditions this is about 90 # acid/ton of 26 gauge steel.

4. Basic Theory of New Bethanizing Process — U. C. TAINTON — *Wire & Wire Products*. Vol. **11**: 225-7 — Bethanizing is a process of depositing very pure zinc on iron or steel. Raw material is a roasted zinc concentrate of

50-60% zn with many other metals. Electrolyte carries 250 g/1 free sulfuric acid. During first stage most of foreign elements pass into solution and with continued addition of zn bearing material, solution becomes nearly neutral. Deposition of zinc at this stage only possible by applying an overvoltage in order to use property of zinc in opposing development of H under this condition. Work is cleaned in a fused caustic bath to get clean surface. Electrolysis is carried out at 700-2000 amp./sq. ft. using lead-silver alloy anodes.

METAL CLEANING & FINISHING

Chevrolet Methods of Finishing Bumpers — By JOHN M. BONBRIGHT — This article furnishes an excellent illustration of the use of automatic machinery in modern production methods. In all cleaning, pickling, and plating operations, overhead conveyors and automatic carriers are utilized to the fullest extent. All rough polishing and buffing operations are performed on automatic machines. Curved surfaces at the end of the bars are polished on an upright lathe in the conventional manner. Rigid inspection during processing and severe testing of the completed assembly insures maintenance of quality standards. E. T. SHEEHAN

Throwing Power and Current Distribution in Plating Baths — Part I By LEONARD C. FLOWERS — Growing emphasis on plating to specifications has centered attention on the necessity of uniform electro-deposits. In general, solutions of high throwing power permit the discarding of shields, auxiliary anodes, etc. The author summarizes past investigations into the factors governing throwing power and presents data suggesting means of further studying this problem. The principles involved, cathode polarization, solution conductance, cathode current efficiency, cathode surface and electron transition are discussed from the viewpoint of the specific effect of each factor.

E. T. SHEEHAN

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Business and Social News

BRANCH NEWS

Educational Activities

WATERBURY BRANCH

Regular meeting of Waterbury Branch A.E.S. was held Friday evening, October 9, in Engineer's Hall, Tennant Elwin, president, was in the chair. After a little routine work the speaker of the evening, Mr. E. C. Jann of the Carborundum Company was introduced. Assisted by Earl Couch of the Lea Company, the speaker presented a number of films in the "Use and Manufacture of Polishing Grain." Starting with several views of Niagara Falls, a trip is made through the plant, showing the big electric furnaces and the way the polishing grain is manufactured. Of special interest were the views showing the discovery of Dr. Acheson, as a result of his experimenting with clay and coke in his crude electric furnace. The speaker answered many questions in connection with his subject and at its conclusion it was the verdict of all that it was a very interesting presentation.

During the meeting, the question of forming a class in the chemistry of electroplating, was brought up by past-president Wm. J. Gray. The object was to enable the young and older plater to know the principles underlying the work he is engaged in. In case the plans go through the class will be in charge of George Museio, who is connected with the Lea Mfg. Co. and Herbert T. Baurer, an instructor in the Mattatuck Collegiate Centers, which in connection with the local branch will sponsor the class. Both instructors are graduates of Yale College, and will undoubtedly prove successful in spreading the light of plating and chemistry knowledge.

Librarian Ellsworth Candee announced that the next speaker will be Dr. R. W. Mitchell of the Magnus Chemical Company, and his subject will be "New Developments in Metal Cleaning." The presence of Dr. Mitchell and the interest manifested in the subject of his talk, should be the means of filling all the chairs at the next meeting, which will take place Friday evening, November 13th.

Wm. F. GUILFOILE, *Sec'y*

PHILADELPHIA BRANCH

Philadelphia Branch held its regular meeting on Friday, October 16, 1936. The meeting was called to order by President Hirsch. The minutes of the previous meeting were read and approved. A communication from Supreme Vice President P. J. Sheehan was read. It was voted that Mr. George Gehling, Past Supreme President, Mr. A. M. Robson and Mr. H. Perry be appointed as the membership drive committee.

Although the weather has been unfavorable the enthusiasm of the members has not been the least bit dampened, as is shown by the attendance and the lively discussions at each meeting.

Our Librarian, Mr. J. Nelson presented Mr. E. W. Lafferty at this meeting. His talk on Solvent Degreasing was well given and was ably demonstrated on the blackboard. Mr. Lafferty showed the cost of operation and the real meaning of Solvent Degreasing including the elimination of fire hazard. After a general discussion Mr. Lafferty was given a rising vote of thanks.

The Banquet Committee reported the Program was nearly completed. There will be an orchestra and song leader. The Educational Session will start promptly at 2.00 P. M. Dr. Wm. Blum, Mr. George Hogaboom, Dr. Sanigar, Mr. J. M. Himes, Jr., Mr. H. Keller and Mr. A. Hirsch will be the speakers. Full announcement of the meeting will be found on another page of this issue of the REVIEW. All members who can, are urged to attend this educational session at 2. The banquet at 7. Door prizes awarded at 9 and dancing starting at 9.15. The place, Adams, N. W. Cor 13th and Spring Garden Sts., Philadelphia.

Remember the date, Saturday, November 21.

Next regular meeting of the branch Friday Nov. 20 at 7.30 P. M. Mr. Davis will be the speaker.

R. E. JACKSON, JR., *Sec'y.*

PITTSBURGH BRANCH

We held our first fall meeting in the nature of a dinner party, which was held last Friday evening October 2nd, in Webster Hall Hotel, Pittsburgh, Pa. We had twenty three members and visitors present and from the interest shown, it looks as if we were to have some more of these interesting meetings. We had the pleasure of having as our guest speaker, Mr. Pine of the Harshaw Chemical Co., Cleveland, Ohio. Mr. Pine spoke on the subject of Bright Nickel and the control, he passed around many very excellent samples of the work, which had been done under production methods in the larger shops in Detroit, these samples brought out a lot of discussion from those present. The following applications for membership were received:

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John P. Huch, Active, 423 Highland Avenue, Johnstown, Pennsylvania.

Daniel Mitchell Davis, Associate, Iron & Steel Publishing Co., Investment Building, Pittsburgh, Pa.

I think that you will agree with me that this is some start for the fall and winter season, and with the indication of plans for the next several meetings, things will be breaking better for Pittsburgh than they have for several seasons.

S. E. HEDDEN, *Sec'y-Treas.*

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held October 10, 1936 at the Atlantic Hotel.

President G. Jelinek presiding and all other officers present.

Mr. F. Herbst, Chairman of our banquet committee reported that the

committee had selected the Palmer House to hold our annual banquet and same would be held on Jan. 16, 1937.

Mr. O. E. Servis, chairman of the Educational program stated that he hoped to have one of the best and most interesting educational programs ever held by Chicago branch.

Mr. Wilcox reported that Mr. W. Uebel had been very ill, but was now convalescing at home and could receive company. Chicago branch officers and members extend their best wishes to Mr. Uebel and hope that he will soon be back in normal health.

Mr. G. Spencer of the Crown Rheostat & Supply Co. made a very interesting and instructive talk on Plating Cost and explained why this very important subject should interest the Plating Foreman. Mr. Spencer proved to be a very interesting talker and gave the boys something new to think about.

Mr. O. E. Servis stated that our very good friend and Honorary member of Chicago Branch, Dr. O. P. Watts, would lecture before the American Society of Metals on Thursday November 5th at the Peoples Gas Building in Chicago and urged all the members to attend as Dr. Watts always had an interesting subject to talk about.

As there were no questions in the question box, the meeting adjourned at 9.45 P. M.

J. W. HANLON, *Sec'y.*

MILWAUKEE BRANCH

Milwaukee Branch annual booster meeting, was held October 8, 1936, President Dexter Rhoades, presiding.

We had a very fine attendance, about forty-five present.

The usual amount of business was transacted as quickly as possible, due to our educational and social hour following.

A motion was made that we begin to think about either a banquet or an educational meeting and smoker to be held after the first of the year.

The meeting was thrown into chaos when Ed Werner, the ladies "Narrator" demanded a banquet. We admire Ed but are afraid he is fighting a losing battle, as the majority seem to favor our combination educational and smoker meeting.

After hearing from our First Vice President, Pat. Sheehan, our librarian Henry Bornitzke discussed questions that were asked.

The windup of the evening was a delicious lunch with that renowned "Milwaukee Special."

R. C. BINDER, *Sec'y-Treas.*

CLEVELAND BRANCH

The regular monthly meeting of the Cleveland Branch of the American Electro-Platers' Society was held at Hotel Carter, Saturday, October 3rd.

The meeting was called to order by our president, Mr. W. D. Scott at 8.15 P. M.

The minutes of the previous meeting were approved as read.

The application of Mr. Terrance O'Neil was approved by our Board of Managers.

Mr. Singler reported on the clam bake held on Saturday September 26 at the Astorhurst as a very successful one and that everyone had a good time. He also had a statement from the Astorhurst that all bills were paid in full.

Motion was made by Mr. Webber and seconded by Mr. Lyons that the report be accepted with a vote of thanks, carried.

Mr. Carlson reports progress and that his committee will have something definite to report at the next meeting.

Our president then called on our national secretary and treasurer, Mr.

Kennedy, for a few words. He gave thanks for the gift that the Cleveland Branch gave to the supreme society.

He then talked on what the society is trying to do and to try and help the chairman in the supreme society in their efforts on the membership drive, and the librarian in arranging speakers and assistant foremen as members, and branch displays at the convention and the REVIEW and what they expect to do.

He then outlined some help for our librarian on what other branches are doing in order to get a better attendance.

Some are taking one certain subject to discuss at all their meetings, so when convention time comes around they will have something definite to report. Others have a question box which had to be started by the librarian putting in the questions in order to get started. After this fine talk our president called for a rising vote of thanks.

Mr. Thompson then spoke on taking up one subject for the year.

Our librarian Mr. Carlson then wanted to know what papers we would like to hear read and discussed. After much discussion it was decided to have "Health Hazards in Plating Room" as the subject we would like to take up for several meetings. If you fellows have any data on the subject bring it in.

On a motion made by Mr. Lyons and seconded by Mr. Carlson meeting was adjourned.

W. E. O'BERG, *Sec'y-Treas.*

DETROIT BRANCH

The Detroit Branch of the American Electro-Platers' Society held its regular meeting Friday evening, October 2, 1936, at the Hotel Statler, with Mr. A. B. Wilson presiding. There was a good attendance, there being approximately 55 people present, which is considered a fair showing for the membership.

The minutes of the last meeting were read and approved. There were no new applications for membership, but the application of Mr. Maxwell W. Wise, of the Parker Wolverine Company was reported favorably by the Board of Managers, and he was unanimously elected to active membership. There was no correspondence, and the bills had been taken care of by the Board of Managers before the meeting.

Reports of committees:

Mr. George L. Nankervis was asked to say something, as he had been appointed chairman of the new membership committee. He reported that they were organizing a very strenuous movement with the manufacturers of Detroit and environs to get every eligible man in the electro-plating industry into the Society during the fiscal year.

Mr. Gustaf Soderberg and Mr. Lindahl, of the Udylite Process Corporation, were then introduced as speakers of the evening, the subject being "The Future of Cadmium Plating." Mr. Lindahl did not have a paper, but he had considerable information. He did not only go into the future of cadmium plating — in fact, he did not go into the future of it — he dwelt on the past and present, and according to statistics which he gathered, during the last 14 years cadmium is on the increase in the electroplating industry — in other words, that the volume is greater at the present time than it has been at any other time in the past. Mr. Soderberg then read a paper dwelling on the present and the future possibilities. Mr. Soderberg's paper will be published in the near future in the monthly "REVIEW.

Our Executive-Secretary, Mr. W. J. R. Kennedy, was also present at this meeting and gave us quite a talk. We were indeed very glad to have him with us and I am sure that he enjoyed being in Detroit — in fact, he mentioned to

me that he had learned quite a bit, and that he was amazed at the volume of electro-plating there is being done in Detroit.

On account of the time, the Question-Box was omitted and the meeting adjourned at 10.30 until our next meeting which will be Friday, November 6, at which time we expect to have Dr. O.P. Watts of the University of Wisconsin. Dr. Watts will give a paper on the corrosion of metals.

T. C. EICHSTAEDT, *Sec'y-Treas.*

ANDERSON BRANCH

Anderson Branch resumed functioning with a bang after two months of inactivity due to vacations and the seasonal slack period. We met for a dinner meeting at the Y.M.C.A. on October 12th with twenty-seven members and guests present.

After dinner, President James Minton presented Dr. D. A. Cotton as the speaker of the evening. Dr. Cotton gave an abstract of his paper which he presented to the Cleveland convention, the title of which was "Buffer Chemicals in Nickel Solutions." The talk was illustrated with slides of graphs showing the curves plotted by taking the pH of solutions of 6 oz/gal and 12 oz/gal Nickel concertration with measured addition of normal sulphuric acid. The buffering chemicals used were boric acid, sodium acetate, acetic acid, citric acid, sodium citrate, lactic acid, succinic acid, formic acid, phosphoric acid, tartaric acid, and hydrofluoric acid. Some of these showed little buffer action while others were promising. Dr. Cotton did not hazard an opinion on the effect of these chemicals on the quality of the plate. Our idea of the value of boric acid as a buffer agent was certainly blasted, especially in Nickel solutions run at lower pH's. The complete paper and graphs are in the convention proceedings and are well worth studying.

It was decided to continue our plating class with William Castell as discussion leader. The subject of plant visitations was brought up as a source of interest.

Meeting adjourned at 9:30 P. M.

LUCIEN R. HINSCH, *Sec'y.*

LOS ANGELES BRANCH

Minutes of the Los Angeles Branch A.E.S. regular monthly meeting held Sept. 9, 1936 at the Rosslyn Hotel. President E. R. Williams presided. Roll was called showing 12 members present. There were four visitors.

Minutes and financial report of the previous meeting were read and accepted. Bills for $32.95 were read and ordered paid.

Mr. Rynkofs reported that his committee had arranged for three speakers for the open meeting in October. The branch decided to have as many samples as possible from the new plating solutions on the market. Frank Rushton was appointed to look after these exhibits. Phillip Virtue resigned from the Society.

Mr. Sollivan brought word that the L. A. High School would furnish a teacher and school facilities for a class in chemistry if enough members were interested enough to justify it. Of those present nine agreed to attend the class. Mr. Sullivan was appointed to complete the arrangements with the school.

The meeting was turned over to Roy Bray, the Librarian who found the following questions in the box:

Q. How fast can copper be deposited from an acid copper solution without causing the deposit to be rough? Neither work or solution are agitated.

A. About .003" per hour.

Q. Can chromium be plated direct on cast iron?

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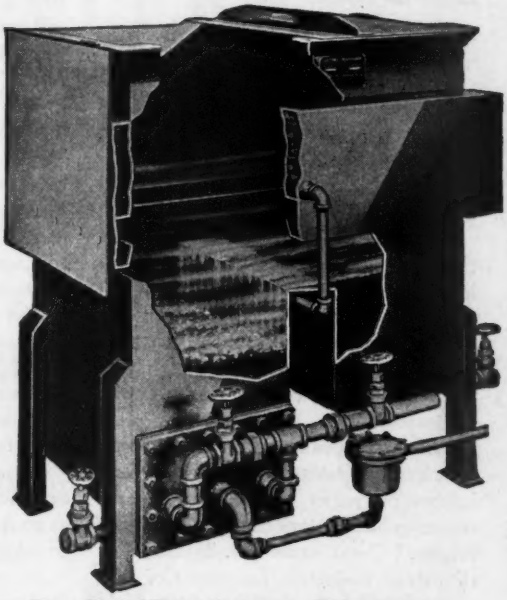

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A. Yes.

Q. What is the best method of plating chromium direct on Aluminum?

A. No satisfactory answer.

Q. What causes brown stains on chromium deposit?

A. Insufficient sulphate in the bath.

Minutes of the regular monthly meeting of the Los Angeles Branch American Electro-Platers' Society, held Oct. 14, 1936 at the Rosslyn Hotel.

Pres. E. R. Williams was ill, so Vice-Pres. John Merigold took charge.

This was an open meeting and was the best attended meeting we have had in several years. We had an attendance of over eighty. Because of the many visitors present and the fact that we had arranged a special program for the occasion, the regular business was dispensed with.

The first speaker was Mr. George Boeck of the Oakite Co. He read a very interesting paper on the causes and remedies for the various types of "water breaks." Next came Mr. McGuire of the Maas Waldstein Lacquer Co. He answered a lot of questions on lacquers. The final speaker was Dr. S. Fischer. He gave us a very technical discussion on bright plating. The gang literally bombarded him with questions after his talk, but we didn't stump him. He was there with an answer for all of them.

The meeting officially adjourned at 10:30 but the last of the unofficial discussions ended about midnight. We had a number of samples there of new finishes, bright plating, etc. and they were handled so much and examined so many times that the owners of them will be lucky if the plating isn't all worn off from them before they get them back.

Altogether this was the most successful meeting we have had in a long time. It made us feel that the depression is over. EARL COFFIN, *Sec.-Treas.*

NEWARK BRANCH

The regular meeting of the Newark Branch, A.E.S. was held on Friday evening, October 16, 1936 at the Krueger Club, Belmont Ave. & Springfield Ave., Newark, N. J.

The meeting was called to order at 8:30 P. M. with President Samuel Taylor, presiding. The following officers were present: Samuel Taylor, President; John Kotches, Vice-President; George Wagner, Secretary; Nelson Sievering, Treasurer; and William Hodecker, Trustee.

The minutes of the previous meeting were read and approved.

An application for Mr. William F. Hodecker, 73 N. J. R. R. Ave., Newark, N. J. as an Active Member, was voted on to take the regular course.

An application for Mr. Wilbur G. Schmidt, 2016 Edgar Rd., Linden, N.J. as an Active Member, was also voted on to take the regular course.

An application for Mr. Louis J. Donroe was reported on favorably and he was elected to Associate Membership.

Mr. Roy Stout, 45 Coit St., Irvington, N. J. was reinstated to Active Membership.

Mr. Horace Smith, Chairman of the Committee, for our Bingo Games Party, urged every member to support this affair by bringing their friends.

Mr. Lewis Graham was called upon for a little talk during the absence of our Librarian. He explained a great deal about generators. The flow of the current; the reversing of the current; and some remedies to overcome this condition.

Mr. Oliver Sizelove was appointed Chairman of a Committee for a drive for new Membership.

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Twenty-four members attended and the meeting adjourned at 10:30 P.M.

GEORGE WAGNER, *Sec'y.*

GRAND RAPIDS BRANCH

Grand Rapids Branch held a get-together meeting at the Zeeland Ornamental Casket Co. as guests of the Ver Plank Bros. A short business session was held at which time our progressive member, Chas O. Werft presented three applications for membership and they were favorably acted upon.

The boys were taken on a tour of the plant which helped to make the evening interesting. Refreshments were enjoyed at the close of the meeting.

CHAS. S. WHALLEY, *Sec'y*

BOSTON BRANCH

Boston Branch opened its fall and winter sessions Thursday, October 15th at the Manger hotel with Pres. Mintie in the chair.

This being an open meeting the reading of the minutes and the regular order of business was dispensed with as we had with us the ladies, Mr. W. J. R. Kennedy, the Executive-Secretary and Mr. Bob Leather of The Lea Mfg. Co., as our guests.

Bob Leather showed the members and their families the pictures taken at the outing at Pemberton Inn, last July and also the pictures of the conventions of 1935 and 36 with the assistance of Joseph Barron one of our new members. The branch enjoyed every minute of the evening. A rising vote of thanks was given Bob Leather and Joe Barron for the very enjoyable time.

Mr. Kennedy spoke of the drive for new members and how the other branches are going about it and that he hoped to see the convention of 1938 come to Boston and was glad to see the way the members are working to bring in new members.

We had with us our first President and pal, Frank Mackie. He was given a great welcome. Mr. Mackie has been very sick all summer and is now feeling as fit as a fiddle. He spoke of the chemistry class that the branch will have this winter and urged every member to get into the class if he wanted to get anywhere, because he said that the plater will have to know his chemistry in order to succeed. He was given a rising vote of thanks and the best wishes of the branch. We hope he will be with us more often.

A rising vote of thanks was also given Mr. Charles Campbell for the good work that he has done for Boston branch in the past.

Three applications were received for membership and turned over to the board of managers to be acted upon at the next meeting as follows: Arthur H. Blake, 24 Merrymount Ave., Wollaston, Mass., Associate; Calvin T. King, 803 South Ave., Whitman, Mass., Active; Thomas F. Barron, Corinth St., Providence, R. I., Associate.

The ladies were with us and they had an enjoyable evening. Refreshments were served and everybody had a good time.

The meeting adjourned at 11 P. M.

ANDREW S. GARRETT, *Sec.-Treas.*

BRIDGEPORT BRANCH

The Bridgeport Branch held a stag outing on Saturday afternoon, September 12, at Eichner's Grove in Bridgeport.

About seventy men were present, among them twenty guests from whom we hope to get some new members.

Lunch was served at noon, and as soon as the crowd was well fed and thirsts quenched we proceeded to the events of the afternoon.

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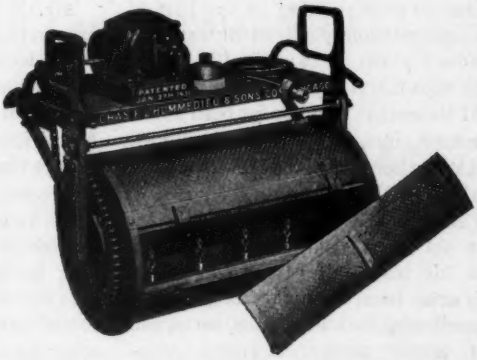

Size of barrel 10 in. x 18 in. Weight 32 lbs. Barrel is made of materials which are acid and alkali resisting and non-absorbent. Can be used with all standard solutions except chromium; also with strong cleaners; and at temperatures up to 150 deg. F. Furnished to operate from A. C. circuit 110 or 220 volt, or from 6 volt D. C. plating circuit.

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BRANCHES: CLEVELAND, LOS ANGELES

DEALERS IN PRINCIPAL CITIES

Races were arranged by Doc Kellner and prizes were awarded by the Branch to the winners. Jack Harper and John Charleson were the outstanding athletes of the crowd.

Jack managed to sneak in a win in the potato bag race by placing a twenty pound rock in the bottom of the bag worn by the undersigned. This severely cramped your Secretary's style.

Due to poor running on the part of the competition Jack then won the hundred yard (or was it 100 foot?) dash with Charleson second.

Al Rosenthal won the fat man's race in record time, although he developed a charley horse a few yards from the finish.

The three-legged race was won by that old money player Jack Harper, with his team-mate John Charleson. This same team crashed through in the forward and backward race, an event that words cannot adequately describe. It seems that one man runs forward while the other runs backward and they then reverse field and go the other way.

The ball-game between the Salesmen and the Working Men was won by the Workers by a score of 8 to 4. Dick Crane of Lea Mfg. pitched for the Peddlers and it looked for a while as if he were trading base hits for orders. He certainly did a land office business.

Joe Sullivan of New Haven Clock pitched for the Tired Business Men and did a swell job. The umpire was on his side anyway.

Dick Crane claimed the Home Run Prize when he scored on a scratch single over the centerfielders head and two or three errors. The center fielder was getting a beer at the time.

A steak dinner with plenty of steak and corn on the cob was the last event of the day.

We were very glad to have as our guest, Bill Kennedy, who although unable to stay for dinner, seemed to be enjoying himself.

The July meeting of the Bridgeport Branch was held on Friday, July 10. There were only a few members present and the meeting was rather informal.

The committee appointed in May to hold an installation party was discharged. No party was held.

Mr. Milton Hodges and Mr. Harry Haven of Electrolux and Fosberg Mfg. were elected to membership. Applications from Frank Foy of MacDermid and Charles McElroy of Bridgeport Metal Products were read and turned over to the Board of Managers.

A committee was appointed to arrange for an outing in September. The committee consisted of Tom Chamberlain, Roland Doucette, Joe Sullivan, Doc Kellner and Herman Braun. The committee received no instructions other than to arrange for the best outing they could.

The Secretary was instructed to write the family of the late P. J. Onkey, a member of the Bridgeport Branch, who died.

George Karl was appointed a member of the sick committee.

The meeting adjourned at 9:30 P.M.

CHARLES H. COSTELLO, *Sec.-Treas.*

SPRINGFIELD BRANCH

The regular monthly meeting of the Springfield Branch A.E.S. was held Monday evening, October 26, 1936 at the Indian Social Club rooms.

The meeting was conducted by Walter Barrus, Vice President, due to the absence of President Seidel.

There were fourteen members present.

The minutes of the previous meeting were read and approved.

The Secretary read a letter from Mr. P. J. Sheehan, first Vice President

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Please mention THE MONTHLY REVIEW *when writing*

of Supreme Society, requesting the Branch to elect a chairman of a membership committee.

Mr. Frank J. Clark was unanimously elected.

A letter from Mr. J. W. Hanlon, second Vice President of Supreme Society, giving the names and addresses of available speakers was read. This letter was turned over to a committee for further action.

The applications of three new members were acted upon and all were accepted as members.

The following are names of those accepted:

Francis W. Reese, Associate Member, Oakite Product Corp. Edward R. Dupuis, Active Member, Ames Plating Co. Derick S. Hartshorn, Associate Member, Westinghouse Elec.

Dr. L. C. Flowers, of the Westinghouse Co., was the principle speaker of the evening. He told the Branch that he would be willing to conduct a plater's class, consisting either of Blackboard talks on chemistry, or actual analysis of Plating solutions, provided the branch would be able to furnish equipment. After some discussion, this offer was referred to the next meeting.

Dr. Flowers has recently returned from the Panama Canal Zone, where he was employed by the U. S. Government. He gave a very interesting talk on the customs and living conditions as he saw them there.

He was given a vote of thanks after which the meeting was adjourned.

H. R. DELARM, *Sec'y*

ROCHESTER BRANCH

The Rochester branch held its regular monthly meeting on Friday night October 16. President Kohlmeier was in the chair. After the regular business session there was a half hour social period during which liquid refreshments were served. The chairman of our educational committee Mr. John Honnacker then took charge of the meeting and a general discussion then ensued. The discussion of course centered around the topic this branch has selected to discuss for this year, which is "Cyanide Copper Plating Baths."

It might be appropriate at this time to state that this idea of discussing one subject for a short period during each meeting for this winter with the view of preparing a paper to be read by one of our active members at the New York Convention was proposed at one of our meetings by Mr. Frank Kolb, Chief Chemist at the Bausch and Lomb Optical Co. and an Honorary Member of the Rochester Branch. And let me say that he not only proposed the idea but is putting all of his knowledge and support behind the effort to make it a complete success.

JUDSON R. ELSTER, *Sec'y.*

NEW YORK BRANCH

The New York Branch held their regular monthly meeting on Friday, October 23rd at the World Building, Park Row, New York City. There was a short business session, followed by one of the old time Branch educational meetings, during which the progress of modern electro-plating as applied to rhodium, chromium and bright zinc processes were lengthily discussed. The meeting was well attended and the membership were engrossed in the interesting topics for an hour and a half.

This was the last meeting to be held at the rooms in the old World Building on Park Row, across from the old

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City Hall, where the Branch has held forth for the past twelve years. It was a farewell meeting and the membership made the most of it. However, the Branch deemed it necessary to locate further up-town so as to be centrally placed and have selected the Pennsylvania Hotel, the 1937 Convention headquarters, for their bi-monthly meetings which will be held as usual on the second and fourth Fridays of the month.

At the first meeting in the new quarters, Friday, November 13th, the Branch will inaugurate their Fall and Winter Educational Programme, with a lecture by Dr. Carl Johnson, technical director of Oakite Products Corporation, entitled "Films and their Significance". The membership anticipates much of interest in this and other lectures that our live wire Librarian, Aaron Englander, has booked on this programme for the long Winter ahead.

F. J. MACSTOKER, *Sec.*

Here and There

The Boston Branch meeting this month was a pronounced success. Bob Leather and Earl Couch with the movie machine furnished the entertainment pictures of the last two conventions and the recent Boston Branch outing created plenty of applause. The pictures which were colored by Joe Barron of Baker & Co., were very good. Some of the members brought their wives and families. Refreshments were served at the close of the meeting. The Hub members deserve commendation for encouraging these social events.

There was a lot of activity before the Boston meeting was called to order. It didn't take long to find out what it was all about. President Arthur Mintie Secretary Garrett, Don Wood, Bert Sage, Charles Campbell and others were boosting the membership. Several new members will be the result. A chemistry class under Bill Cahill's direction will be under way pretty soon.

Don't forget to read carefully the article on membership by Walter Barrows of Toronto Branch. No face is more familiar at the Conventions and no name more respected than that of Mr. Barrows. The article referred to shows the keen interest our good friend shows in his own Branch. We hope other branch members will find inspiration in reading this paper.

Secretary Stanley E. Hedden of Pittsburg Branch sent a fine report of his branch activities this month. Pittsburg Branch may be small, but it has powerful possibilities with men like Messrs. Peters and Hedden at the helm. Watch Pittsburg Branch grow.

Anderson Branch has started activities again after the summer months. Dr. Cotton and Mr. Castill both well known for their interest in the A.E.S. are actively at work in the educational program of the local Branch.

The men who dug the Panama Canal had a song

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> Got any mountains you can't tunnel through?
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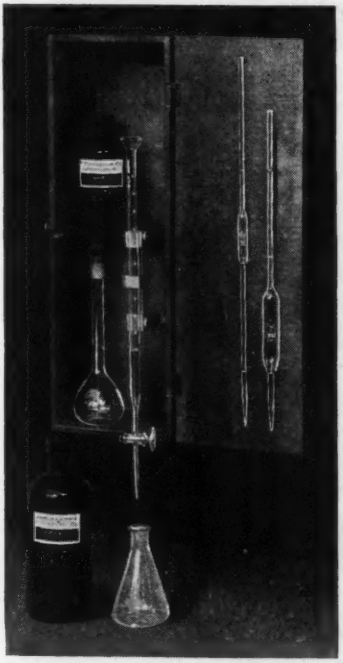

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The automatic, conveyorized, vapor-type of Detrex Degreaser illustrated in Fig. 1 has been recently designed and built by the Detroit Rex Products Company, 13010 Hillview Ave., Detroit, Mich., for the cleaning of heavy gauge metal parts.

This machine is equipped with a two-strand, cross-rod type of conveyor, which has a variable speed drive. There are 17 special fixtures suspended from this conveyor on 30 in. chain centers to handle the work baskets through the degreaser. Roller-type gravity conveyors at each end of the machine provide automatic loading and unloading.

Electric immersion heaters, and thermostatically controlled magnetic relay and line switch are used. The machine is also equipped with a full automatic vapor level control device.

This model of degreaser is built in various sizes to accommodate production requirements. The particular machine shown is 20′ long, 6′3″ wide by 9′8″ high. It has a rated production capacity of over 6,000 lbs. of heavy gauge metal parts per hr. at a conveyor speed of 1 ft. per minute.

Parts are received on the gravity roller conveyor loaded in grill-type metal baskets having perforated plate separators. These work baskets are automatically lifted from the conveyor fixtures and carried through the machine. While in the machine, the parts are subjected to vapor cleaning in pure solvent vapor - either Perm-A-Clor or Triad Safety Solvents being used. The baskets of work on being conveyed out the opposite end of the machine are automatically transferred onto the gravity rolls at the exit end. From here they are conveyed to the following heat treating or finishing operations (depending upon the requirements of the work).

The complete cycle of vapor cleaning requires only about 4½ minutes. The work is removed from the machine perfectly free of oil and dry.

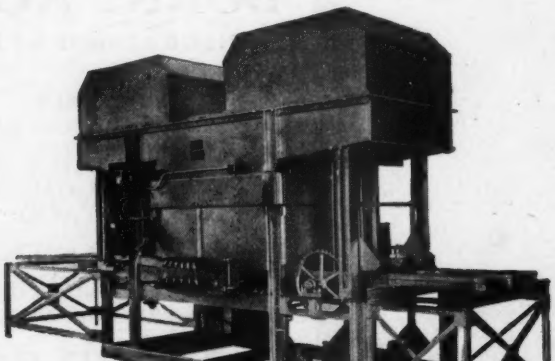

Fig. 1 (Photo 123,420) Automatic vapor-type Detrex Degreaser used for the production cleaning of heavy guage metal parts.

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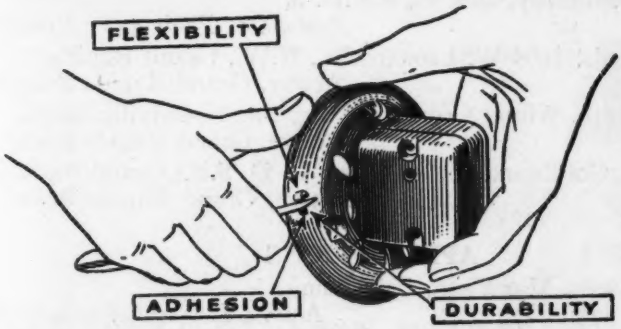

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Membership Report

To October 18, 1936

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Associate, Detroit Branch

Alfred Robinson, 654 Elliott Street, Detroit, Michigan
Active, Detroit Branch

Alfred George Fox, Active, Toronto Branch

Derick S. Hartshorn, Jr., Associate, Springfield Branch

Francis W. Reese, Oakite Products Co.
Associate, Springfield Branch

Edward R. Dupuis, Chicopee, Mass.,
Active, Springfield Branch

Maxwell M. Wise, Parker Wolverine Co., 2177 Milwaukee East,
Active, Detroit Branch

Milton E. Hodges, Electrolux Inc., Old Greenwich, Conn.
Associate, Bridgeport Branch

Frank E. Fay, Ansonia, Conn.
Associate, Bridgeport Branch

Harry B. Hanen, 523 East Broadway, Milford, Conn.
Active, Bridgeport Branch

Charles J. McElroy, Box 94, R.F.D. 3,
Associate, Bridgeport Branch

Claude Wieds, 1604 W. Leonard St., N.W., Grand Rapids,
Active, Grand Rapids Branch

John R. Smith, Winter Crompton Mfg. Co., Grandville, Mich.
Active, Grand Rapids Branch

Herbert A. Guldbrandsen, Aberdeen R. D. S.E., Grand Rapids,
Active, Grand Rapids Branch

APPLICATIONS

C. C. McLaren, Mar Vista, California
Active, Los Angeles Branch

William F. Hodecker, Jr., Newark, N. J.
Active, Newark Branch

Wilbur G. Schmidt, 2016 Edgar Road, Linden, N. J.
Active, Newark Branch

REINSTATED

Roy Stout, 45 Coit St., Irvington, N. J.
Active, Newark Branch

RESIGNED

Philip Virtue Los Angeles Branch

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Membership Campaign

October, 1936

Branch	Elected	Reinstated
Bridgeport	4	
Detroit	3	2
Grand Rapids	3	
Springfield	3	
Dayton	1	
Philadelphia	1	
Toronto	1	
Newark		1
Anderson		
Baltimore-Washington		
Binghamton-Elmira		
Boston		
Chicago		
Cincinnati		
Cleveland		
Hartford		
Los Angeles		
Milwaukee		
Montreal		
New York		
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Providence		
Rochester		
San Francisco		
St. Louis		
Toledo		
Waterbury		

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MacDermid Inc., Waterbury, Conn.
Matchless Metal Polish Co., Glen Ridge, N. J. and Chicago, Ill.
Frederic B. Stevens, Inc., Detroit Mich.
Harrison & Company, Haverhill, Mass.
Bias Buff & Wheel Co., 430 Communipaw Ave., Jersey City N. J.
General Abrasive Co., Inc., 1800 College Ave., Niagara Falls, N. Y.

Burnishing Compounds

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Oakite Products Inc., 52H Thames St., New York City
Magnus Chemical Co., Garwood, N. J.
Rumford Chemical Works, Rumford, R. I.
Magnuson Products Corp., Third and Hoyt Sts., Brooklyn, N. Y.

Degreasing Machines

Detroit Rex Products Co., 13010 Hillview Ave., Detroit, Mich.

Equipment

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Maas & Waldstein Co., 432 Riverside Ave., Newark, N. J.
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H. V. Walker Co., Elizabeth, N. J.
The Stanley Chemical Co., East Berlin, Conn.

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Hanson-Van Winkle-Munning Co.
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Research

Lowell Research Laboratories, Lowell Mich.

Soaps

Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York City

Solution Control Methods

Hanson-Van Winkle-Munning Co., Matawan, N. J.

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Executive-Secretary: W. J. R. KENNEDY, — 90 Maynard St., Springfield, Mass.

BRANCH DIRECTORY

ANDERSON

Meets first Monday of every month at 7.30 p. m. at the Anderson, Indiana, Y.M.C.A. Secretary, L. R. Hinsch, 407 W. 11th St., Anderson, Ind.

BALTIMORE-WASHINGTON

Meets at Bureau of Standards, Washington, D. C., the first Saturday of each month. Secretary, Irvin H. Hahn, 207 Sharp St., Baltimore, Maryland.

BINGHAMTON-ELMIRA

Meets first Monday of each month at the Y. M. C. A. in Binghamton. Dinner at 6.30 p.m. Secretary, Larry Meyer, 70 Kneeland Ave., Binghamton, N. Y.

BOSTON

Meets at Hotel Manger, Boston, Mass., first Thursday each month. Secretary, A. W. Garrett, 100 King St., Dorchester, Mass.

BRIDGEPORT

Meets first and third Fridays of each month at Chamber of Commerce Rooms, Stratfield Hotel, Secretary-Treasurer, Charles C. Costello, 1285 Boulevard, New Haven, Conn.

CHICAGO

Meets second Saturday of each month, at 8 p. m., Atlantic Hotel, 316 S. Clark St., Secretary, James Hanlon, 3004 N. Whipple St., Chicago, Illinois.

CINCINNATI

Meets last Friday of each month at 8 p. m., at Y. M. C. A. Secretary, Joe Adler, 1613 Kellywood Ave., Cincinnati, Ohio.

CLEVELAND

Meets first Saturday of each month at Carter Hotel, Secretary, Wm. E. O'Berg, 2191 W. 29th St., Cleveland, Ohio.

DAYTON

Meets first Saturday of each month at the Y.M.C.A., Dayton, Ohio. Secretary, Ward B. Protsman, 141 Westwood Ave., Dayton, Ohio

DETROIT

Meets the first Friday of each month at the Hotel Statler, T. C. Eichstaedt, Secretary, 679 Virginia Park, Detroit, Mich.

GRAND RAPIDS

Meets second Thursday of each month, 7.30 p. m., at 55 Mt. Vernon Ave. Secretary, Chas. S. Whalley, 931 Pine Ave., N W., Grand Rapids, Mich.

HARTFORD

Meets the 2nd week of each month in Elks Club, Bristol and the State Trade School in Hartford on alternate months. Vernon E. Grant, 18 Birge Road, Bristol, Conn., Secretary.

LOS ANGELES

Meets second Wednesday of each month at 6.30 p. m., at the Rosslyn Hotel, 2nd floor, N.W. Cor. of 5th and Main Sts. Secretary, Earl Coffin, 710 E. 29th St., Los Angeles.

MILWAUKEE

Meets second Thursday of each month at Cor. 3rd and Highland Ave. Secretary, Roman C. Binder, 1515 W. Atkinson Ave., Milwaukee, Wis.

MONTREAL

Meets second and fourth Friday of each month; at 1437 Aylmer St., Montreal, Quebec, Canada, where the Secretary-Treasurer, Mr. Charles Doherty, can be found at any time.

NEWARK

Meets first and third Fridays of each month, at Krueger Club, Belmont Ave. at Springfield, Ave., Newark, N. J., at 8 P. M. Secretary, George Wagner, 1134 So Long Ave., Hillside, N. J.

NEW YORK

Meets second and fourth Fridays of each Month, in the Hotel Pennsylvania, New York City, N. Y. Secretary-Treasurer, Frank MacStoker, 25 Princeton St., Garden City, L. I. N. Y.

PHILADELPHIA

Meets third Friday of each month, in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts. Secretary-Treasurer, R. E. Jackson, Jr. 125 E. Allen St., Philadelphia, Pa.

PITTSBURGH

Meets first Friday of each month, at 8 p. m. at U. S. Bureau of Mines, 4800 Forbes Street Pittsburgh. Secretary, S. E. Hedden, 227 Fifth St., Aspinwall, Pa.

PROVIDENCE-ATTLEBORO

Meets first and third week of each month. Notice by card. Secretary, J. H. Andrews, 19 Rosedale St., Providence, R. I.

ROCHESTER

Meets third Friday of each month, at Hotel Seneca, Sec.-Treas; J. R. Elster, 295 Rawlinson Road, Rochester, New York.

SAN FRANCISCO

Meets at Plaza Hotel, San Francisco. Secretary, H. W. McKibben, 310 Tehama St., San Francisco, Cal.

SPRINGFIELD

Meets the fourth Monday of each month at the Indian Motocyle Social Club. Henry Delarm, Sec. 330 Plainfield St., Springfield, Mass.

ST. LOUIS

Meets first Friday of each month, at the Plant of the Lassalco Co., 2828 LaSalle St. Secretary, C. T. McGinley, 1606 Bradford, St. Louis, Mo.

TOLEDO

Meets first Thursday of each month, in the office of Spanoli Plating Co., 3120 Monroe St., W. W. Welker, 2228 Middlesex, Drive, Toledo, Ohio.

TORONTO

Meets fourth Monday of each month, at Canadian Foresters' Hall, 22 College St., Room No. 2. Secretary-Treas., H. Hands, 146 Gowan Ave., Toronto, Ontario, Canada.

WATERBURY

Meets second Friday of the month, at Engineers Hall, No. 11 East Main St. Secretary, Wm. F. Guilfoile, 14 Oakland Ave., Waterbury, Conn.

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at our expense

Gray area indicates original outline of ordinary polishing grain. Black area, grain after chemical treatment which leaves a deposit on the grain. A superficial coating only. Poor surface adhesion. Short wheel life.

Gray area indicates outline of grain before etching. Black area, grain after etching. Note surface is in itselt rough, being composed of tiny pores. Greater surface adhesion. Longer wheel life. Faster, keener cutting.

Many manufacturers have already proved in their own plants the superiority of CBT LIONITE grains.

Provided with a working sample—invited to make their own tests—they found that this grain *is actually etched* for greater surface adhesion, that it *does* lengthen wheel life, that it enables *far better* polishing at *much lower* cost.

The polishing room efficiencies and economies CBT LIONITE has brought to them, it can bring to you, too. Write for your working sample today!

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IN PLANT PARLANCE

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At 2 o'clock each afternoon foremen from each department meet to discuss the various jobs in production—to coordinate each phase—to make sure that orders are on schedule—TO HELP EACH OTHER DO A BETTER JOB. The "bull session" is only one of the many intangible ingredients that go into the making of the "finish that counts".

While we take pride in our over half century record of meeting production schedules we realize too that there are always new problems —that we can't stand still. This is another reason we cordially invite you to bring your finishing questions to our Stamford or North Chicago laboratories.

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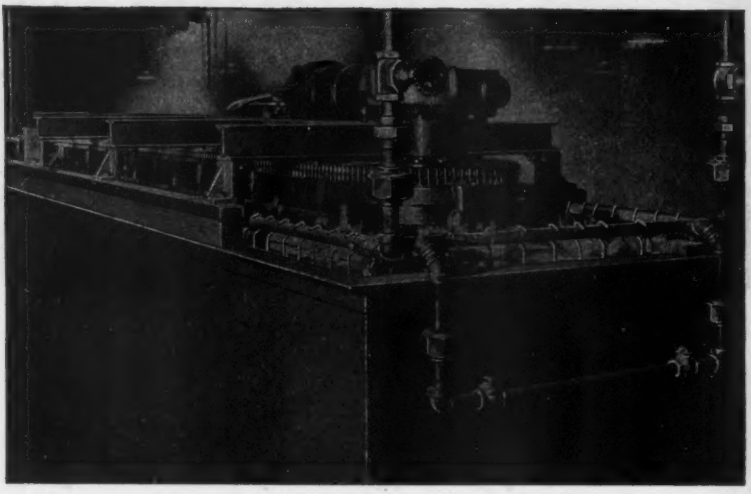

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